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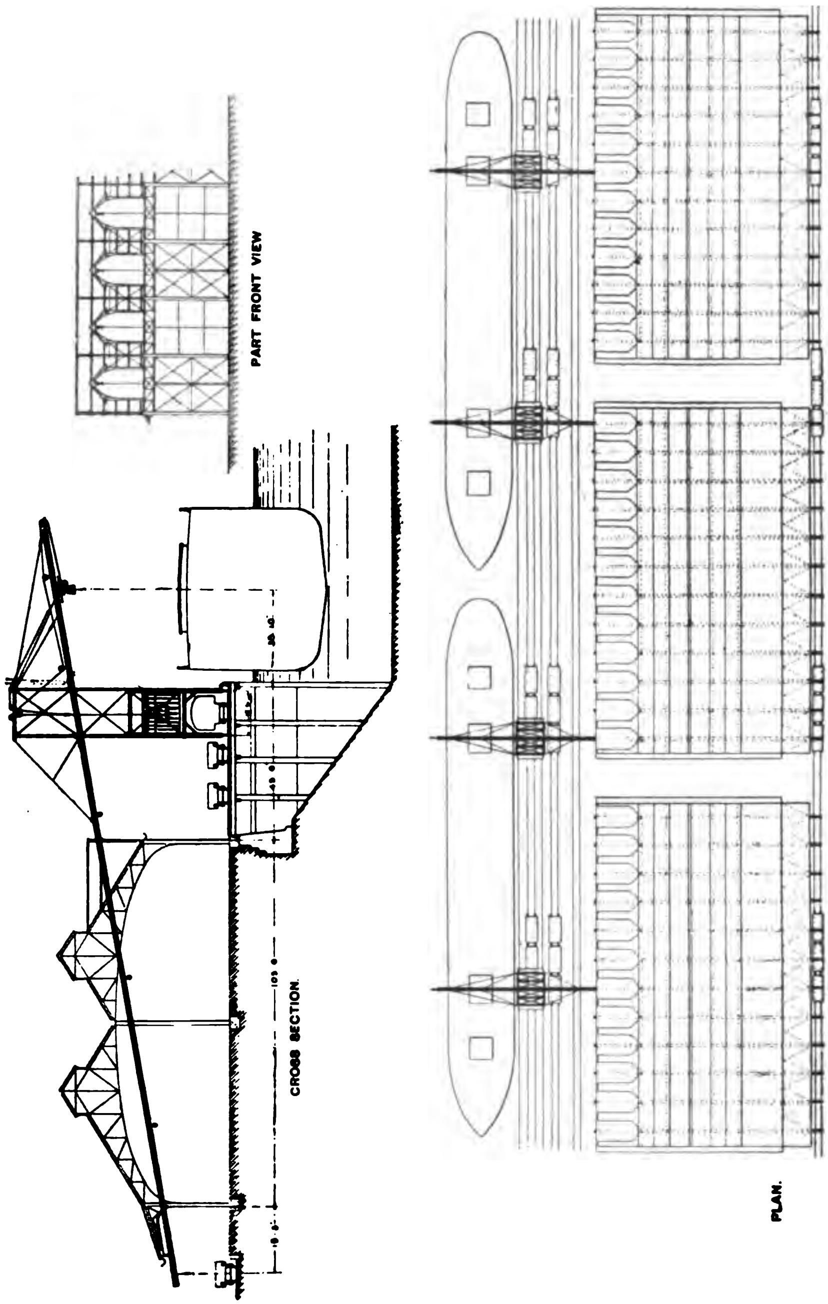
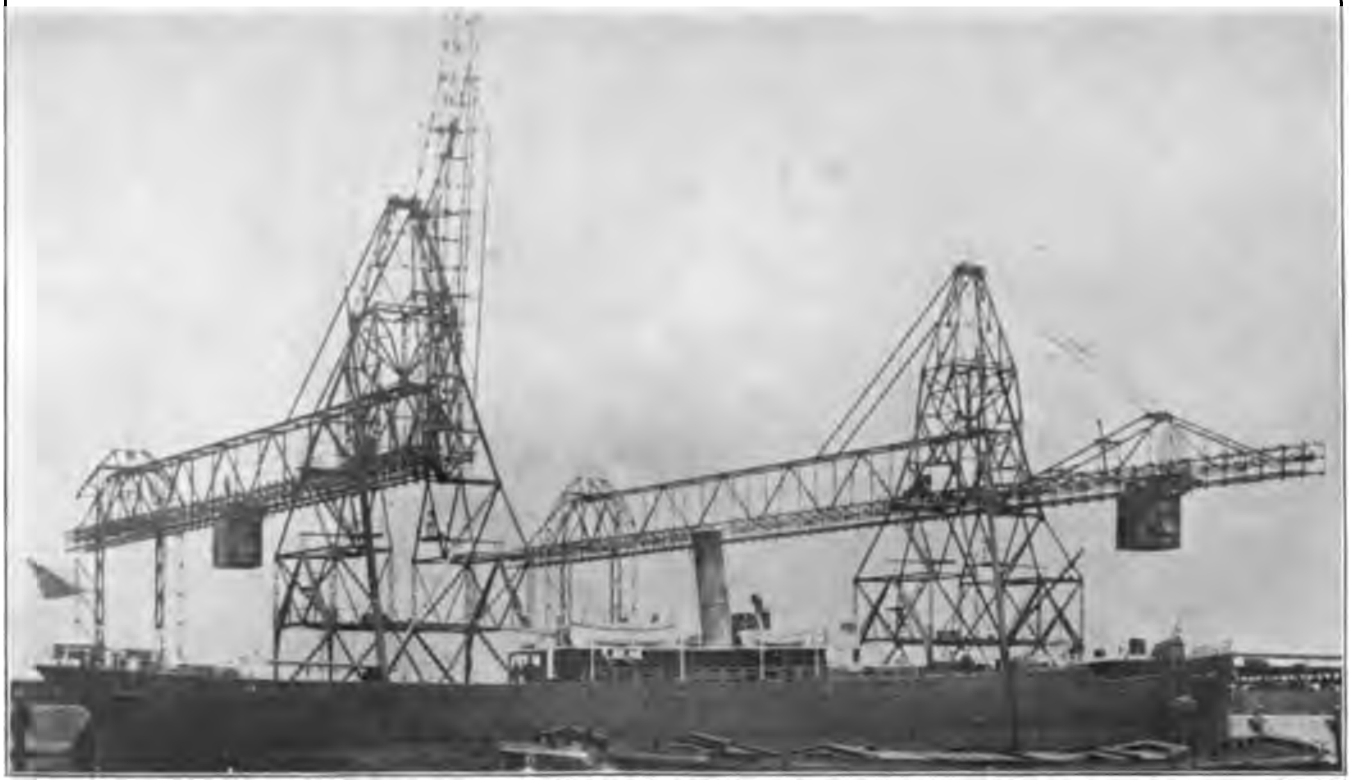
INDEX FOR LAST HALF OF 1907



English Traveling Tower Transporter at Delagoa Bay.

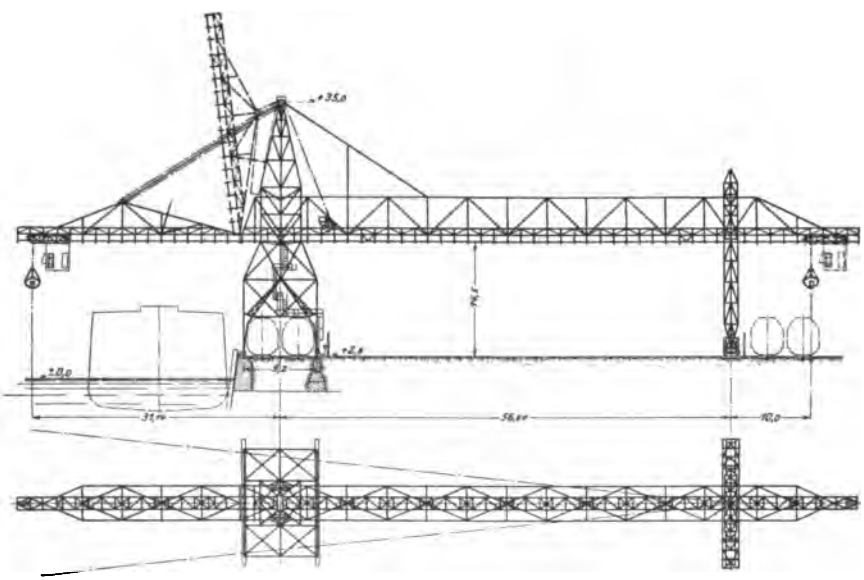


Two German Loading and Unloading Bridges at Emden Harbor.

German bridges is 1.2 meters per second, the lowering speed being 1.8 meters per second, while the trolleys travel on the bridges at a speed of from 3 to 3.6 meters per second, and the bridges themselves may be moved by electric power at a speed of .3 to .4 meters per second. The capacity of these bridges for hoisting is from 60 to 90 ton hours. The total length of operation for the traveling trolley is 98 meters, while the overhanging section is 26 meters in length. The electrical equipment was installed by the Siemns-Schuckrt Company, Berlin, Germany.

At Delagoa Bay there are a number of English traveling power transporters of the type shown in the accompanying drawings, constructed by the Timberly Transporter Company of London. These were built for the transit sheds of the Portuguese government and are of the raised platform type, so designed in order that the railway truck may pass underneath them, and are arranged to couple up with any of the fixed beams, the driver effecting this coupling from his position. There are four traveling towers at Delagoa Bay and 36 fixed transporters at the Transit shed.

The fixed beams are spaced 5 meters apart and reached through the shed and over the railway trucks at the back of the shed. The goods are hoisted from the vessel by means of a traveling power transporter and are lowered either into trucks on the quay, into any



German Loading and Unloading Electrically Operated Traveling Bridges.

Two Conveyor Bridges at Detroit Iron & Steel Co., Delray, Mich. Electrically operated and equipped with Hulett 5-ton bucket. One cantilever raised.

position in the shed, or directly into the trucks at the back of the shed.

These English transporters are operated electrically, the hoisting speed with full loads being 75 meters per minute, while the transporting speed reaches as high as 250 meters per minute. This plant was designed for discharging vessels, it is stated, but can be used in the reverse direction, that is for taking goods from the railway trucks into the shed or directly into the vessels, as well as from the shed into the vessels.

In America a number of interesting and successful types of conveyor bridges have been placed in operation, utilizing electric power. The accompanying illustration shows two Hulett conveyor bridges at the plant of the Detroit Iron & Steel Company, at Delray, Mich., with five ton ore handling excavating buckets. These bridges are electrically operated and are provided with cantilevers, one of which is shown in a raised position in the accompanying view.

The great steel companies of the United States are probably using labor saving devices to a greater extent than any other class of manufacturers and undoubtedly on a larger scale. Electric power is being utilized to the utmost in the endeavor to obtain the greatest economy of operation, the greatest output in a given time and at the lowest possible cost. For unloading ore at the docks of the steel companies on the Great Lakes electric power is used largely, and is found most economical and satisfactory in operating this class of machinery.

At the Lackawanna Steel Plant at Stony Point, Buffalo, five electric driven Hulett automatic ore unloaders are employed, while at Lorain, Ohio, a number of these unloaders are also used by the United States Steel Corporation at the National Tube Co.'s docks. These electric automatic unloaders were installed by the Wellman-Seaver-Morgan Co. of Cleveland and are equipped with special cantilever extensions particularly designed for delivering the ore on a high bank back of the machines.

Electrical energy is utilized at the steel works at Buffalo, N. Y., very extensively for operating labor saving devices of every description utilized in handling steel, rails, ore, coal, coke, limestone and other material.

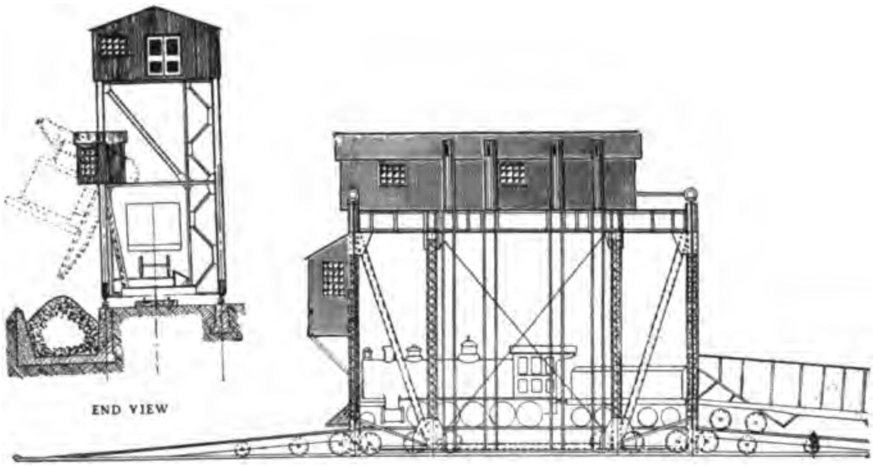
The Lacakawanna Steel Company have a large electric power station containing eight 1000 horsepower gas engines driving both alternator and direct current dynamos, the fuel being the waste gases from the furnaces. Advantage is also taken of these gas furnace

gases for operating 16 200-hp-Koerting gas engines of the blowing type for supplying drafts to the furnaces, making 30,000 horsepower available from the use of this waste fuel. Thousands of horsepower are also developed by steam driven electrical generators, and Niagara power is about to be utilized also very largely for operating electric motors at this plant.

There are a number of Hulett conveyor bridges installed with two-part automatic buckets, each holding 70 tons of ore, the operating mechanism being driven entirely by electric motor. The total length of each bridge is 374½ feet long. A similar bridge equipped with a 7½ ton excavating bucket for ore was installed at the plant of the Cambria Steel Company at Johnstown, Pa.

The movable overhead bridge is mounted on an "A Frame" shear leg at the rear and with double "A Frame" machinery tower at the front. The bridge is provided with a runway for carrying the trolley and a two-part automatic bucket. The machinery is substantially the same as provided for previously described bridges, except the car haulage is omitted. Where the center span is unusually long, which would make the cost high for maintaining a cable system, the machinery is all mounted on a bucket carrying trolley, doing away with

Hulett Patent Car Dumper for Coal, on dock of B. R. & P. R. R., Buffalo, N. Y.



The Modern Car Dumper.

flying ropes throughout the length of the bridge. Conveyors of this type are usually electrically operated, although steam power can be used when found more convenient or economical.

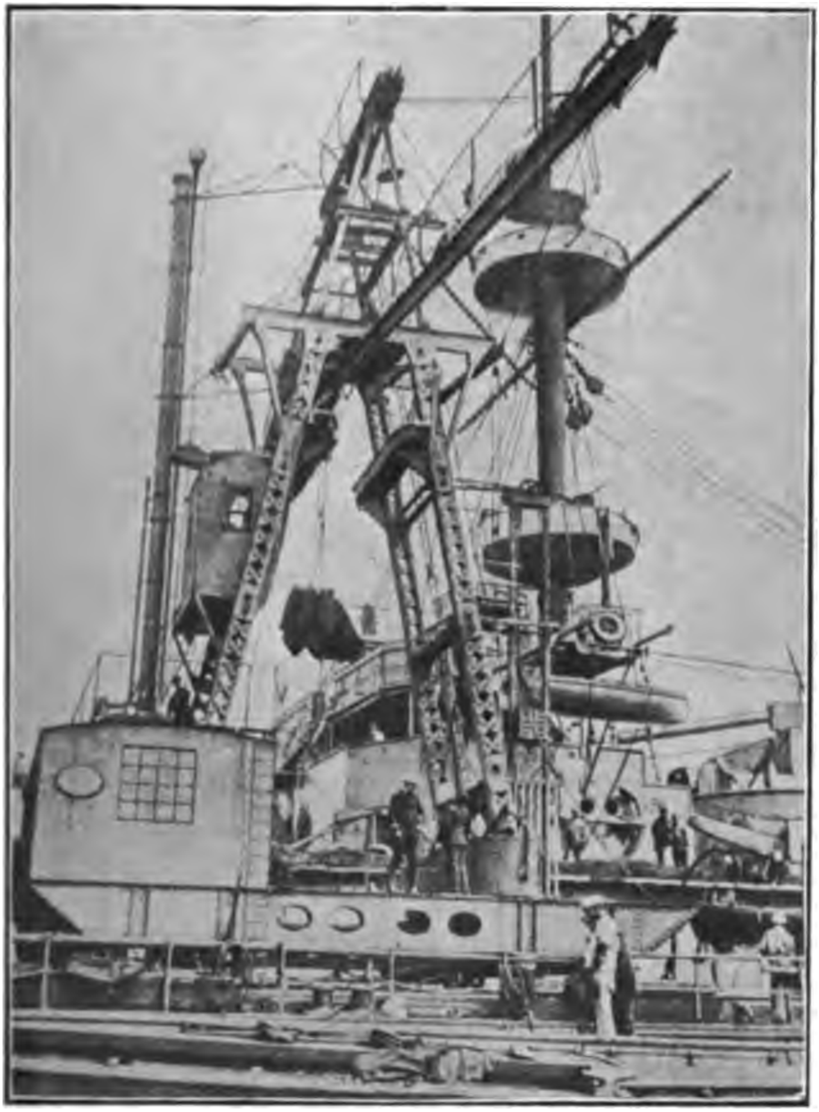
It is claimed that when the center span is not too long, however, it has been found to be more economical to use the rope system for operating the bucket, from the fact that the machinery for hoisting the bucket is necessarily very heavy, and if mounted on the trolley adds very considerably to the strength required for the structure necessary. By a rope arrangement and the magnetic controller system the operator rides in a cab on the trolley, and still has perfect control over the hoisting motors, which are located in the machinery house on the substructure of the tower.

The bridge is moved over the stock pile and the ore picked up with the automatic bucket and carried back over the gantry bin. This bridge has a center span of 293 ft. 6 in., and a vertical height of 86 ft. from the bottom of the stock pile to the under side of the runway. It has a cantilever extension of 48 ft. over the railroad tracks at the front of the dock, and a cantilever extension of 33 ft. over the ore bins.

The electrical machinery for operation of this structure consists of two 130 horsepower open type reversing motors equipped with magnetic controllers operated from the cab on moving trolley. Brakes are operated by electric solenoids, and motors are equipped with an additional solenoid brake. The motor for cross travel motion is railway type, and mounted on the moving trolley. The hoisting drum is

hoppers or bridge cars for storage yard purposes. Large coke oven plants find that car dumpers are very economical machines for discharging tneir coal and transferring the same to receiving bins.

In order to avoid undue breakage of the coal, the fall of the ma-



Electrically Driven Loader handling supplies to a battleship.

terial is lessened in the car dumpers installed at the dock of the B. R. & P. R. R. at Buffalo.

It is stated that the coal is first dumped into large buckets with movable bottoms. These bottoms are inverted V shaped, and are drawn up close to the tops of buckets before load is discharged into them. The bottom lowers gradually as the buckets fill and thus prevent a sudden fall of the coal from a distance. The two buckets will hold the load of the largest cars. While the empty car is being lowered back into position, the buckets are carried out over the boat by means of two conveyors, and are lowered to the bottom of the hatch, where the top of the bucket is raised up and away from the inverted V shaped bottom, allowing the coal to gradually discharge. It is claimed that this machine has proven entirely successful in operation, and is capable of easily handling 6500 tons per day of ten hours.

The loaded cars are run down by gravity, one at a time, from inclined supply tracks leading to the base of the approach to machine. The approach track slopes up to the cradle of the machine, as does also the discharge track. After the car is in position at the foot of the incline approach it is pushed up the incline and upon the cradle of the car dumper by an auxiliary haulage car called the "mule car." This mule car is propelled by a cable which is driven by a haulage engine built into the base of the machine, and provided with powerful clutches and brakes. The mule car is operated by the same man who inverts the cradle of the car dumper.

It is stated that when the coal is of a class which would not be damaged by falling, it is sometimes preferable to use another form of car dumper which hoists the cradle and the car to such an elevation that the material can be loaded direct into the hatches of the boat, or into bin or other receptacle, by means of suitable aprons or chutes. Such a direct car dumper is used at the coke ovens of the Lackawanna Steel Company. This machine dumps the coal into a large bin, from which an underground belt conveyor takes it across a tunnel to the foot of another long conveyor, which carries it up into large receiving bins.

Electric power is used for operation. The motor equipment consists of two 80 horsepower railway type motors for the car tipple mechanism, and one 130 horsepower open type motor for the mule car haulage. The apron of the machine is built with extra heavy plates so that pig iron can be dumped over it when desired. As pig iron will leave the cars at a much less angle than coal will flow it can readily be received into a separate bin.

The modern dipper dredge is simply an evolution of the primitive machine shown in Fig. 5. There has been a gradual development in this line for the last century, and practically all of the improvements in this type of machine have been made in the United States.

Primitive Development. The first designers of dredging machinery simply attempted to imitate the movements of a hand operated shovel or spade. By referenc to Fig. 5 it will be seen that the movements of the shovel in this machine are quite similar to the movements of an ordinary spade. There is a long period of development between the crude shovels of the first machines and the huge dippers of the modern dredges. Nevertheless, the development was a logical one, and the modern dipper dredge is the result of the combined efforts of many designers working under many conditions and at different periods. Several of the early designers also attempted to utilize

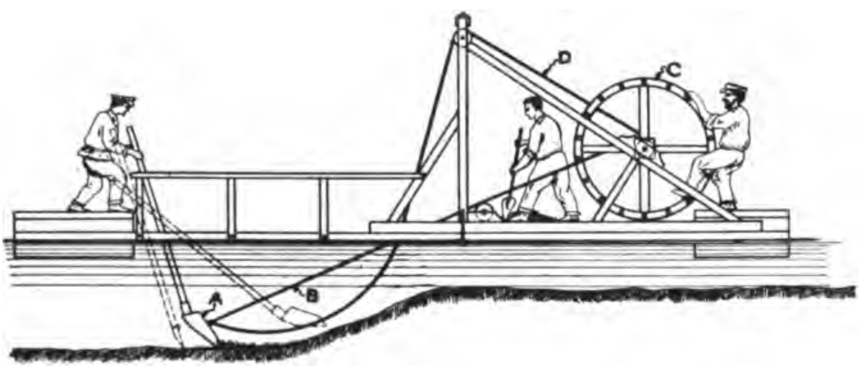


Fig. 5

the flow of the current in order to operate their machines. One of the early dredges operated in New Zealand was anchored in the middle of the stream and the dredging machinery was driven by two huge paddle wheels placed on either side of the boat. The same idea of utilizing the flow of water is manifested in the design on Figure 6.

Early Types. One of the earliest types of dredging machines is illustrated in Fig. 5. A is a large shovel which is dragged along the bottom of the stream by means of the rope B and wheel C. D is a rope for raising the shovel up to the top of the barge floor so that the contents of the shovel may be dumped. An interesting feature in connection with the machine just illustrated is that a machine identical in principle and almost in every detail of construction is now in oper-

ation on the Ivdell River, Russia. The Russian machine is used for dredging gold from the gold-bearing sand from the bottom of the river bed.

The machine shown in Fig. 6 is somewhat unique in construction and was in use over thirty years. It consists essentially of two wings A, pivoted on the back of the barge B. At the back of the barge is a scraper C, which may be raised and lowered by a rack and pinion movement on the barge deck. The wings A may be drawn in or allowed to swing out toward the bank, by means of the ropes D. The operation of the machine is as follows: It can be used only in very shallow water, and is taken up-stream a certain distance. The wings A are then allowed to spread out so they reach the two adjacent banks. In this way a temporary dam is formed across the stream, and this causes the water behind A and B to rise. This produces a certain hydraulic head which will force the machine down stream.

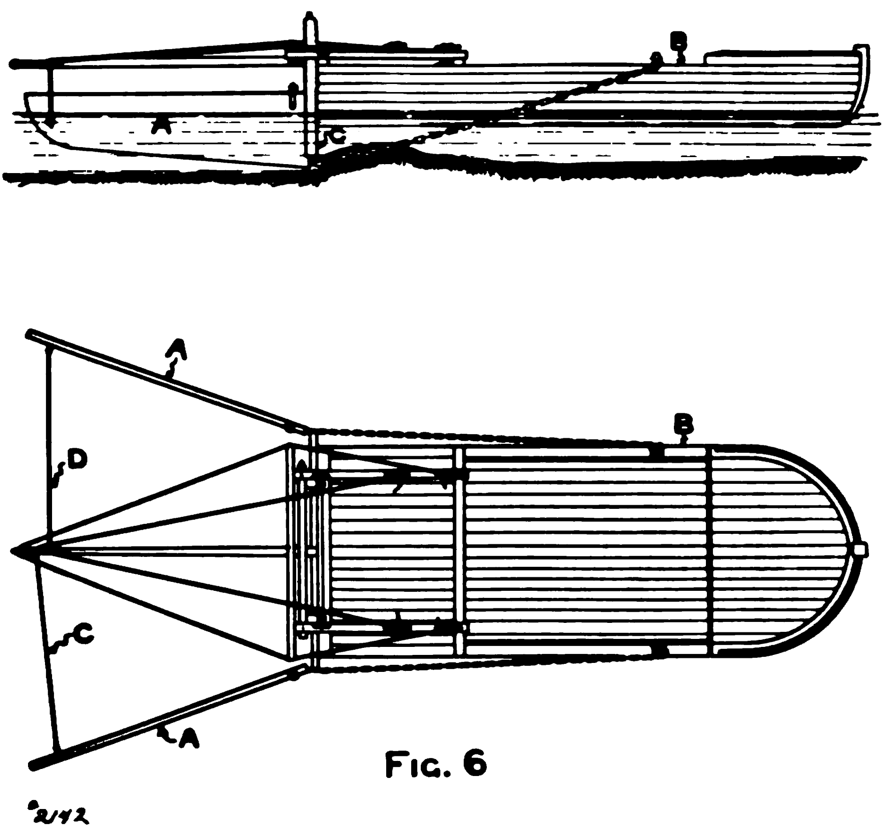


FIG. 6

Just as soon as the machine begins to move the scraper C is lowered and begins to gather up the sediment on the bottom of the stream bed. The entire machine then moves down to the mouth of the stream, where the dredged material is deposited. This particular machine was used for dredging the stream to the distance of five miles, and when first used the water was but 12 inches deep. Over 4 feet of silt was removed at the bottom of the stream by the use of the machine in question, and about the same time that this machine was in operation another one somewhat similar to it but consisting of two boats capable of spanning a stream 16 ft. wide was used for similar work. The field of usefulness of a machine of this type is, of course, very limited, but nevertheless it represents an interesting phase of the development of the modern dredging industry.

First Steam Dredge. The first steam dredge which was built in 1796 was equipped with a 4 horsepower beam engine designed by James Watt. The machinery was placed on a flat bottom boat 20 ft. wide, 60-ft. long, 6-ft. deep and drawing approximately 4-ft. of water. The excavating mechanism consisted of four spoons placed on an endless chain. These spoons were made up of an iron frame which did the cutting, and an oxhide sack behind the frame, into which the material was deposited and then carried up to the place of discharge. Each spoon had a carrying capacity of approximately one ton of dirt. There is a long gap between this first machine and the modern steam dredge now in operation, but notwithstanding this fact, this first machine embodied practically all of the essential principles that are in use at the present time, the only improvements being in perfecting the mechanism and making the machines heavier.

(*To be continued.*)

Inter-Factory Communication.

IV—CRANES.

By O. M. Becker.

USEFUL as it is, the overhead trolley, or traveling hoist, as it is called when applied to heavy loads, has its limitations. For loads up to about six tons, there is usually no especial difficulty in hanging suitable tracks; and indeed there are installations which handle loads of ten tons or more, generally however where it is not necessary to depend upon ceiling or roof beams for supporting the tracks. Usually it is best not to attempt to handle such heavy loads regularly on trolley tracks.

The trolley likewise has the disadvantage of serving only that portion of the floor space directly beneath the tracks. Where comparatively light loads are handled, and it is desirable to reach practically the whole floor surface, it is of course possible to hang any required amount of trackage. For heavy work however this is not practicable; and it is better to install the traveling crane, as well for its greater range of service as for its practically unlimited load capacity. This type of conveyor, like most of the others now so common, is of comparatively recent origin, the first power traveling crane having been designed scarcely twenty-five years ago. From that crude affair actuated by a rope and rope wheel, to the present highly developed electric crane is not really so far a cry as might appear. Since the application of electricity to the powering of travelers, which occurred within a few years of the first appearance of the type, the development has been almost wholly in the perfection of design and increased capacity. Aside from the substitution of improved hoisting devices for the heavy winches first used, the hand traveler, for which there is still occasional place, is essentially unchanged.

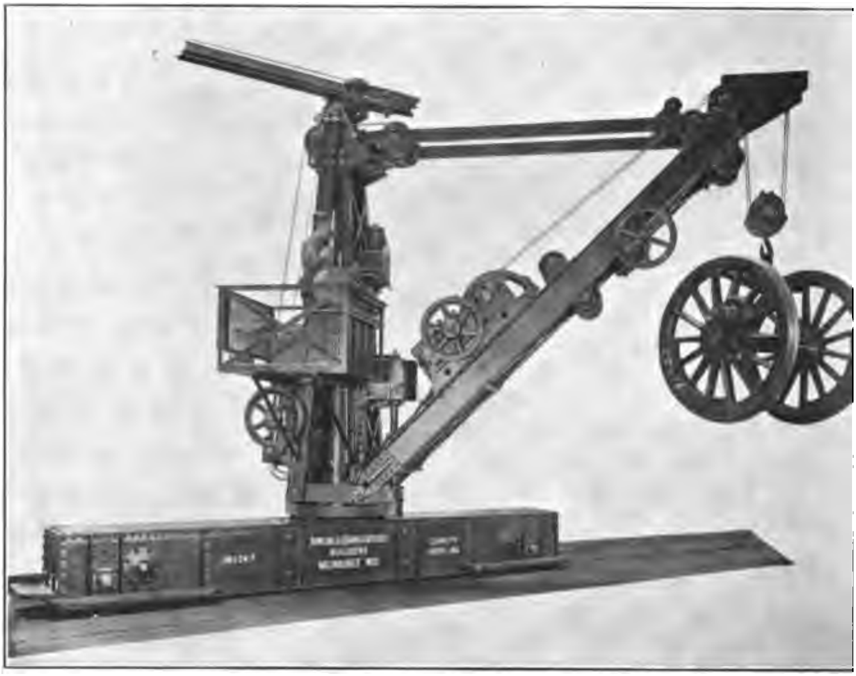
The traveling crane, combining as it does the vertical movement with movement at right angles as well as parallel to its axis, makes it possible to serve not only every inch of floor surface beneath the crane ways, but also every point between the floors and the ways; and makes this type of conveyor essential to such places as heavy foundries and erecting shops, and almost essential in heavy machine shops and packing or shipping rooms.

The customary method of handling pig iron. The foundry supplied from this yard melts an avera; of 200 tons daily, Consider what a crane and lifting magnet would do in this case.

than the one) is spanned by a crane bridge of suitable capacity, serving the whole bay; or if the shop be large and one crane insufficient for the work required, several bridges. It is not now uncommon either

The overhead traveling crane ways extended through the end of the building and into the yard Jeansville Iron Works, Jeansville, Pa.

A small portable truck crane useful about a machine shop. Hand operated.



The walking jib crane is a recent development, making it possible to give traveling crane service parts of shops not accessible to other forms of cranes.

in this way with every part of a factory, by adapting the trolley sy tem to the carrying of trucks or trolleys similar to those in use upc the cranes. Of course this could not be done in the case of cranes large capacity; but even here the trolley tracks can be placed so th loads suited to their capacity can be transferred directly to them f transport beyond the range of the cranes.

This matter of correlating the various systems of transport in plant means much to its general efficiency, and it is important th all these agencies be so adjjusted that each takes up just that class transporting to which it is best adapted, at the points where sor other mode of handling ceases to be the most efficient. It seer scarcely necessary to point out therefore the need for running i dustrial and standard gage tracks to points accessible to the trav ing cranes, and for supplementing each of these agencies with su others as may add to the total efficiency. In some shops, for examp the traveling crane is most efficient when used to carry material the required place, the work of handling at that point or while und going a particular process being performed by some supplementa

One of the biggest cranes ever built. "The Hercules," at yards of the Newport News Shipbuildi & Drydock Co., Newport News, Va.

The jib crane mounted on a portable platform or truck base al: has a wide range of applications. Its usefulness in connection wi the railway tracks (industrial as well as standard gage) has be pointed out. Of course jibs and pillar cranes of this type are limit to the vicinity of these tracks; and it is often desirable to have

The traveling wall crane is an innovation somewhat resembling the jib crane, having the g
advantage of mobility. It is of course to be used chiefly as an auxiliary to the overhead trave
crane, and its advantages are easily seen by reference to the illustration.

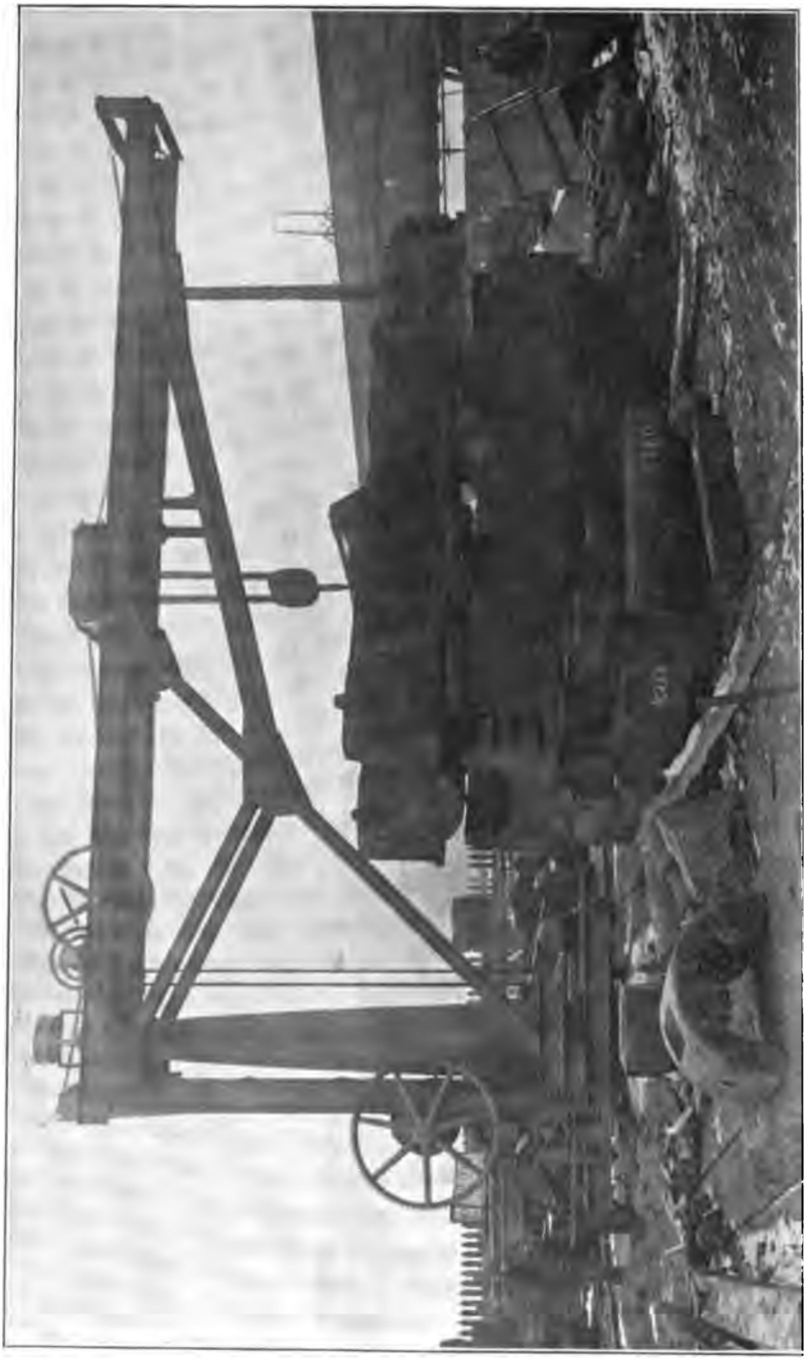
making it possible to reach points beyond the premises, or over whi it would not be convenient to provide traveling ways, this type of tension crane permits the use of a lighter, or rather of a shorter bric span. Obviously the peculiar field for this type of crane is the ya It is quite possible however to so design the building and crane not only to make it available for inside use, but very desirable for tension into the side bays, in this way obviating in some cases need for supplemental travelers in the bays.

Within buildings and in small yards the erection of ways for ov head travelers presents no especial difficulties; and the spans can more or less suited to the needs of the crane service—or rather crane bridges can be designed to meet the requirements of span weight to be carried. In large yards, say lumber, steel storage, sometimes coal storage, the supports for overhead travelers wc

The locomotive crane is almost indispensable. As here illustrated it is equipped with a mag lift, for handling pig iron.

ber, which would be its chief use in such a place. For handling (and the like, the locomotive crane equipped with grab buckets about the best combination available.

It goes without saying, almost, that no crane is complete un equipped with a suitable hoisting device, for this is indeed an inte; part, and in the case of the simpler jib and similar cranes, almost whole of the crane. The hand tackle or drum, air lift, and elec hoist each have particular spheres of usefulness. The drum reel hand crank hoist, even for comparatively light work, is obsolete,



Except for handling loose material like earth and coal, there seems to have been until very recently almost no progress in the development of devices for efficiently slinging or otherwise holding material in transport by cranes. Grab buckets and the like containers, for homogeneous materials, are so well known and so highly developed as to need little notice here.

Grab hooks and similar devices for quickly and securely getting hold of boxed or crated materials and things of irregular form, however, are almost unknown. It is still customary to make use of rope or chain slings, or other clumsy methods of similar purpose, in handling materials of this kind. There may be some good reason for this; but it would seem that better appliances could be devised. This has been done so far as iron and steel in bulk is concerned, by an adaptation of the electro-magnet to the purpose. There is no comparison in the efficiency of this method and the use of laborers in, say, the handling of pig iron or structural steel.

The magnetic lift makes it possible to handle all kinds of iron and steel, including scrap, with something approaching efficiency. Even heavy machinery can be picked up by the mere turning of a switch. Some of these magnets are so delicately adjusted that they are used in sheet mills and other shops requiring the handling of large sheets, for picking up a large number and distributing them as required, dropping one at a time at the desired spot. This is done by suddenly turning off the current and quickly switching it on again before any but the lower sheet have gotten beyond the attractive influence of the magnet.

New York to San Francisco by Water.

By R. A. P.

THERE are several routes by which this may be accomplished; the most common one, by way of Cape Horn, is soon to be rivaled by means of the Panama Canal. Now there are a line of steamers plying between New York and Colon and Panama and San Francisco that make the trip seem nearly all by water, for the 40 miles across the Isthmus is only 3 or 4 hours' duration. It is a trip well worth the time and very cheap in price and it affords an opportunity to view one of the greatest feats of engineering in this decade.

Taking a ship at New York of the Royal Mail Steam Packet Co. which touches several ports before reaching Colon, we proceed to Colon. The traveler may stop over at Kingston, Jamaica and take a trip to Cuba, but when continuing on the same boat he only has about two days at the former place. In that time much can be seen by getting a carriage and guide at $5.00 from 8 o'clock A. M. until 8:30 P. M., and in that time cover considerable ground. This Steamship Company has a good set of seaworthy boats and treatment on board is fine. This boat touches at Limon, a port of Costa Rica, and our first illustration is of a street, in this city, along one of the beautiful parks.

Making a landing in a high wind.

The headquarters of the Labor Department.

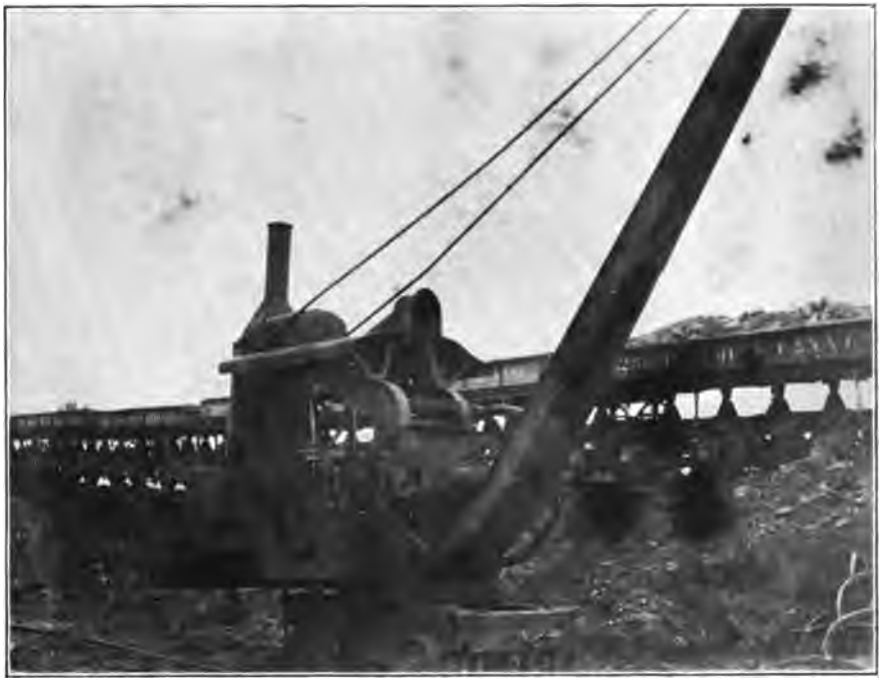
The "dry weather" houses. Screen sides but not protected from rain.

in a vast excavation work the tracks often have to be shifted to follow the terraces. Consequently they could neither be well fixed, nor well ballasted, nor well drained. These necessities, combined with the brusque and violent tropical rain, the bad quality of the workmanship in that country where depression and fever were rife, and the clayish and slippery nature of the soil of the isthmus, ended in running off the rail, in accidents which occurred over and over again, and which were the great, the only and the essential difficulties of the excavation of the Panama Canal. Yet all the Commissions admitted as implicit truth, as an axiom that the canal would be excavated dry. They then discussed the maximum and minimum form compatible with the mode of execution from the sea level canal closed by tidal locks on the Pacific side to the lock canal with a summit level, more or less high, in the center of the isthmus. Now that particular mode of execution is not the only one as the various commissions had thought. The excavation, transportation, and dumping might be affected in the dry, on rails, but it might also be affected on water. The excavation in the dry is not the only mode of excavating—

Portion of harbor crane built by Wellman-Seaver Morgan Co., Cleveland, O.

Negro quarters with plank walk.

Discarded locomotives and supplies left by the French.

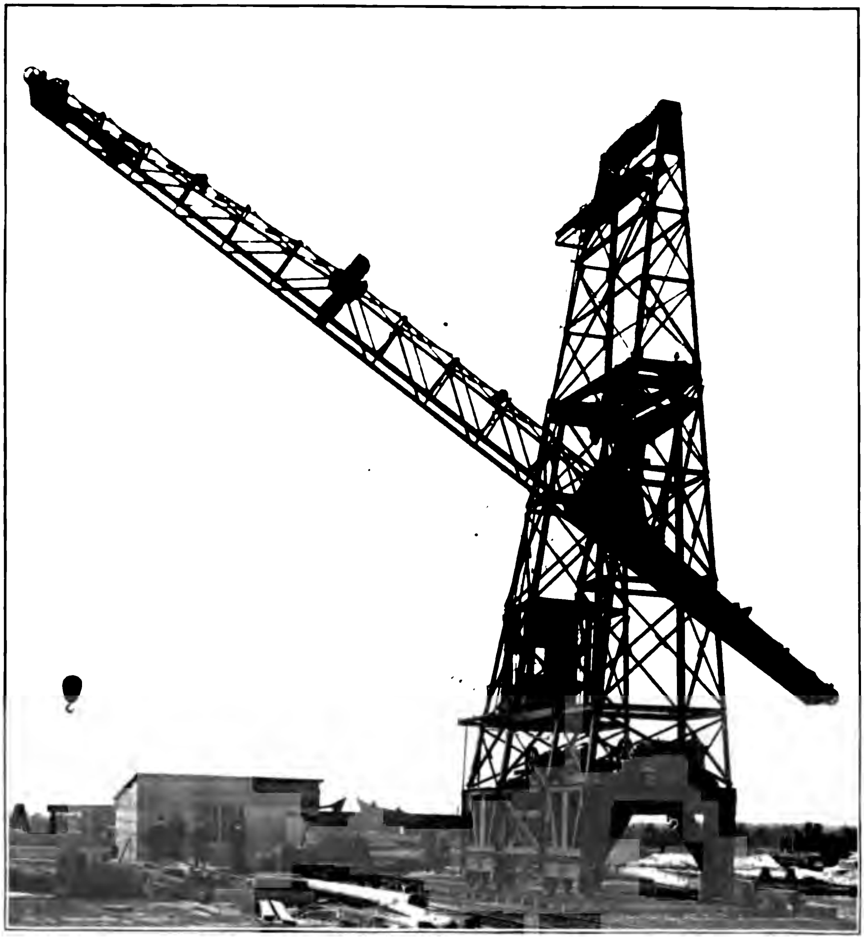


An old crane still used and in good condition. The workmanship on this crane was very high class

it was also the worse, the more expensive and the poorer one. The defects which existed in temperate regions increased in incredible proportions under the climatological conditions of the Panama isthmus.

With the excavation by floating dredges, transportation by barges and dumping in deep water, all the isthmus difficulties would vanish as if they had been touched by a magician's hand.

Thus there would be no more need of an enormous army of workmen, changing every minute some of the tracks, in order to follow the progress of the earthwork. No more need for the ceaseless care to be taken with the movable tracks, which had necessarily poor foundations and could not be disposed for supporting any heavy traffic. No more need for struggling against the sudden tropical floods, which brought down on the tracks the mud torn up from the slopes of the cut, submerged them, ruined their foundations or buried them. No more need of stopping a series of steam shovels for the frequent runnings off the rails, which these unavoidable conditions of the soil and climate brought about constantly, blocking for whole days communication between the points of loading and points of unloading. No more need to struggle



This is an illustration of one of a lot of eight cranes built by the Shaw Electric Crane Co .Muskegon, Mich., for the Panama Railroad Co. They are used for handling miscellaneous freight at the Laboca Wharf, which is the Pacific terminus of the railroad. The boom is 80 feet long, and the tower stands 62 feet above the track.

put to use at several points since the water would spread some and allow several machines to work close together. There are several types of machines that could be used, and the materials excavated carried any distance required, even to being dumped at sea.

It could rain and rain, no work need stop on that account if the engineers were protected, and this they would have to do to secure the greatest efficiency.

Thus it will be seen that dredges of the many types could be

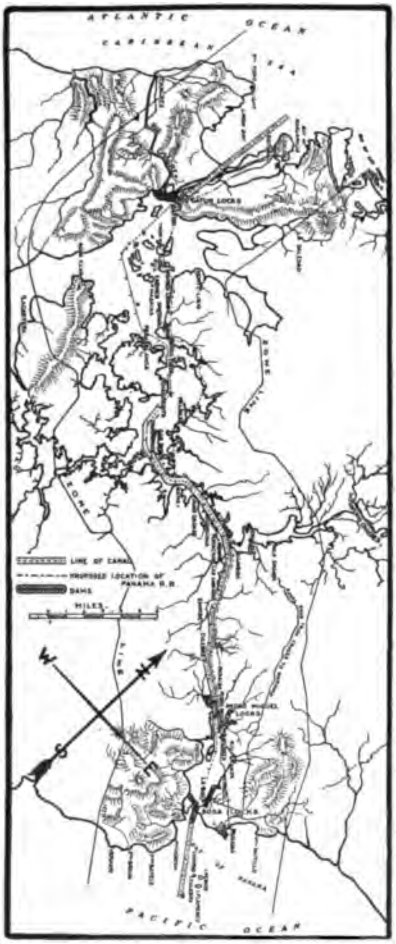
A native mill and brick stack along the route of the canal.

One of the U S Police Patrol

employed without any drawback. As a matter of fact, dredges with buckets of one cubic yard were at present in use. As there were fifteeen passing per minute they were capable of bringing up from the bottom more than 22,000 cubic yards in a day of 24 hours. Making a very liberal allowance for stoppages and other causes of diminution of work, the most pessimistic of dredges would not figure for one of these instruments on an effective yielding of less than 7,000 cubic yards measured in the excavation. And dredges of that capacity were not the most powerful ones.

These figures may seem small, but there are dredges in Great Britain which had buckets of about 2 cubic yards, that was, which could give a useful and practical yield of 14,000 cubic yards per day, in the most unfavorable circumstances. With the transport by water a barge could easily carry 2,000 tons of material, that was about 1,000 cubic yards of the heaviest ground measured in the excavation, and even more. The number of hands on board a dredge doing this enormous work would be fifteen men if it was a steam dredge, and ten men if it were worked by

A hand power crane in the foreground. In the background a locomotive crane of the Browning Engineering Co., Cleveland, Ohio, U. S. A., loading machinery to be taken to another shop.



Map of the Isthmus of Panama.*

makes a turn and runs almost directly southeast to the city of Panama which is on the northwest part of the Bay of Panama, a branch of the Pacific Ocean.

Coming from the United States one is usually somewhat twisted with regard to directions and it is hard to believe that the sun can be seen rising over a body of water which we have always associated with the West and the setting of the sun. However, a reference to the accompanying illustration will soon straighten one out.

Major Geo. W. Goethals now has charge of the canal work and with a number of able assistants from the Engineer Corps is carrying it on in a most satisfactory manner. It is generally conceded by these men, and by many others who are in a position to know, regardless of what knockers and muckrakers have to say, that 1915 will see the completion of the greatest engineering feat of the age.

The trip up the Pacific Ocean is from 19 to 27 days, depending on the boat and the weather, the distance being about 3,400 miles. Many stops are made, the greatest distance at sea at one time is 850 miles off the coast of Lower California. At these stops are at least one country each north of Panama which are all Spanish.

As we steamed into the bay at San Francisco we faced a view similar to another one on our route, that at Kingston, Jamaica, for both are recovering from loss by earthquake.

* By courtesy of "Yellow Strand," St. Louis, Mo.

Wire rope should not be considered as a means of transmitting power in the place of belting or fibre rope, except in extreme cases, such as rolling mill hot beds or similar work, as in case if the installation required, is too long for belting, then fibre rope should be used, and if too long for the latter, electricity will be found far more efficient in the long run, although the first cost for the installation may be much greater.

There is no valid reason why a wire rope should be made or used with a steel center. It is commonly presumed that a rope made in this manner is of a higher ultimate strength, but such is not the case to any appreciable extent, and even if so its wearing qualities are seriously interfered with because of the comparatively highly increased rigidity, and if being considered as a standing rope, for light suspension bridge work, it will be better practice to purchase the ordinary rope strong enough for the purpose, then the purchaser will not be misled.

As before remarked, a piece of wire rope that shows a uniform abrasion of all the crown wires signifies ideal conditions, and this is one that only happens in isolated cases, and when such is apparent, to prevent accidents, it is necessary to note carefully the visible wear, as this is of the utmost importance in determining the probable remaining life of it, always bearing in mind that the rope is not any stronger than its weakest point; therefore, this is the one that must be carefully looked for, and if found, closely watched; and further, in this connection, if the rope is of a standard type, i. e., six strands with a hemp core, there is no necessity for an internal examination, as the defects, if any, will in all instances appear on the outside wires of the rope.

It seems remarkable that there are comparatively so few handy men that are capable of splicing wire rope satisfactorily, in view of the fact that it is so generally used, and also that so much can be saved by this means. It is possible that this is due to an element of fear on the part of some one that the first attempt may prove a failure. The manufacturers, some of them at least, have certainly done their part towards this end, and in this connection it may not be misleading to say that common sense coupled with good judgment ought to help out anyone that is desirous of accomplishing this end. The following tools, being the principal ones that are necessary, are mentioned: two steel marlin spikes of a quality of steel that can be tempered. They should be about 14 to 16 in. long and one inch thick for a little more than one-half of their length, thence tapered very gradually to a point, polished and then hardened, the temper being drawn to about the same degre as for a spring, and with a view of assisting the matter further, it may be suggested that the first

the load is hauled still nearer the support the angle will be more severe. A reference to Fig. 2 shows the angle of a 2½ dia. plow steel cable under exactly the same conditions as to load and span, but under the proper tension to handle the work laid out for it without being overloaded, and this matter is brought to the readers' attention in this connection with a view of showing what may cause premature fatigue of a cable for this purpose.

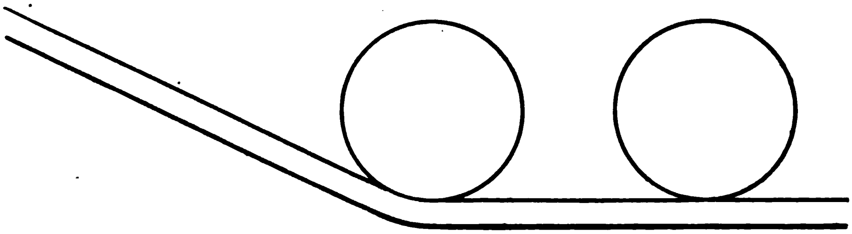


Fig. 1

There is another matter that can be brought to the readers' attention relative to cables for cableways, which is the following: There is usually a fixed point for discharging the load, and if so, this is a serious one and will rapidly cause destruction of the cable, as are also those parts of same over the saddles, of supports, on towers, and relief can be provided for this feature if the purchaser will, in arranging for the cableway, buy a few extra feet in length, so that after the plant has been in operation time enough for the cable to show signs of wear at the discharge point, then this position, and of course those over the saddles of supports, can be changed by slacking off a few feet at one end and taking in at the other. This, it will be noted, provides new actual working positions for the cable, and just exactly where they are most required, because, as a matter of fact, if it is used until it finally breaks the fracture always takes place at one of these points.

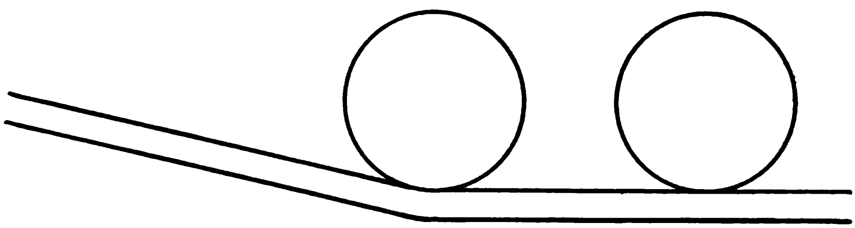


Fig. 2

It is of importance, as before mentioned, that sheave wheels of as large a diameter as is possible be used, and that their grooves should be

made to fit the diameter of the rope to be used, and if the wheels commence to cut in the grooves they should be removed and either re-turned in the groove or discarded. Mild cast steel sheaves are far superior to cast iron for this purpose, and will amply repay for their cost in the rope saved.

Referring to hoisting or winding drums, the life of the rope can be prolonged if they are scored to fit the diameter of the rope to be used, provided, however, the drum is large enough to carry the requisite length of rope required for the purpose without overwinding, but if not large enough there is no necessity for scoring, and the customer will have to put up with the consequences which in very many instances are unfortunately unavoidable, as on tail rope haulages for mining and other purposes.

Who's Right?

The particular storm center around which has raged the fiercest of all the technical controversies of the Panama Canal, is to be found at the Gatun dam and locks; and, of all the questions debated in this connection, perhaps the most important is that of the character of the rock underlying the site of the locks. The opponents of the high-level canal, and notably Mr. Lindon W. Bates, have bitterly opposed the creation of the Gatun Lake, mainly on the ground that the character of the whole underlying ground throughout the 7,000 or 8,000 feet covered by the dam and locks was unsuitable, either to carry the heavy superincumbent load of the structures, or to resist the tendency of the impounded waters to break through by extensive seepage through the subsoil. Mr. Bates has claimed, moreover, that the hill which has been chosen for the site of the locks does not present a sufficient length, measured along the axis of the locks, to contain the whole structure from entrance to entrance.

For many months past an extensive series of borings has been made at the site, and several test-pits have been sunk to the full depth of the lowest lock foundation, the latter being constructed of sufficient size to allow the engineers to descend and make an inspection of the successive strata of ground as thus exposed to view. Furthermore, these test-pits render it possible to excavate the material in large enough masses to make adequate tests to determine the bearing power of the rock and its permanence when exposed to the atmosphere.

When the borings and test-pits were completed, and with a view to a final determination of the question, a special committee composed of three of our leading hydraulic engineers, Messrs. Alfred Noble, chief engineer of the East River tunnels of the Pennsylvania Railway Company; Frederick P. Stearns, of Wachusett Dam fame, and John R. Freeman, who was largely responsible for the adopted plans of the new Catskill water supply of this city, went to the Isthmus, and after an exhaustive examination have reported favorably to the Secretary of War. Not only does the report remove the very serious doubts which have been aroused by the criticism above referred to, but it discloses apparently an even better condition of things than the sponsors of the Gatun dam and locks had supposed to exist. These engineers, individually, entered each of the test-pits, the deepest of which was extended to a depth of 87.4 feet, and they found that after passing through a few feet of overlying clay, the pits entered a rock formation and continued in the same to the bottom. Timbering was required only in the overlying clay, except in one or two cases, where it extended for a few feet below it; but from the clay down to the bottom of the pits the rock was standing well in the vertical walls, and this in spite of the blasting which is required during excavation.

With one exception the rock is of a fine-grained, bluish-gray, argillaceous sandstone character, being, in fact, the same material that has often been referred to as indurated clay. In hardness it may be compared with some of the clay shales; but it is massive rather than laminated. The exception mentioned was a conglomerate rock found in the lower eight feet of the first test pit. Although a small amount of water filtered into each of the pits, in no case was the quantity large enough to be of practical importance. During the visit of the engineers, a test of the supporting power of the rock was made by load-

augurated by act of congress is extremely uncertain, but we think there is no question of its accomplishment within a few decades. The vast interests involved and the character of the people of the Mississippi Valley afford a guarantee that this magnificent scheme will be persistently pushed to completion.—*Washington Post.*

Industrial Oppression.

A fund of $1,500,000 is to be spent in fighting "industrial oppression" in the next three years was called for by President Van Cleave of the National Association of Manufacturers at their annual convention in this city today. President Van Cleave appointed a committee of thirty-five manufacturers to find a way to raise the money.

President Van Cleave then delivered his annual address. Mr. Van Cleave announced his plan at the conclusion of his annual address, in the course of which he declared the principles of the association to maintain the open shop; to oppose the boycott, limitation of apprentices and limitation of output, and to oppose dictation by labor unions. He also declared that the manufacturers must combat the newer issues caused by the determination of labor union leaders to terrorize the President, the Congress, judges and juries.

President Van Cleave added: "We want to federate the manufacturers of this country, to effectively fight industrial oppression. The president ought to have fully $500,000 a year for the next three years. We should certainly provide ways and means to finance the association, to federate the monopolies of the country, and to educate our manufacturers to a proper sense of their own duty, patriotism and self-interests."

President Van Cleave then appointed a committee to confer with him as to ways of raising money. The committee includes Wm. B. Roper, of Virginia; Ellison A. Smythe, of South Carolina; D. A. Tompkins, of North Carolina.

The association placed itself on record by the adoption of a report submitted by the committee on Interstate Commerce, opposing any compulsory reduction in the rates for transportation of passengers by railroads. The committee in its report expressed the opinion that any such reduction would be accompanied by an increase in freight rates.

A bronze tablet bearing resolutions expressive of the association's appreciation of the services of David M. Parry, of Indianapolis, former president of the organization, was unveiled and presented to Mr. Parry.

Mr. Parry then read a paper on certain phases of various problems growing out of commercial obligations. He said that not only did the Constitution of the United States permit the organization of trusts, but the persistence of such organizations showed that there was an economic demand for them.

A report by the committee on merchant marine was read by its chairman, D. A. Tompkins, of Charlotte, N. C. It recommended that the bill of Senator Gallinger, to promote the merchant marine, be passed, and the meeting at once passed a resolution without debate, favoring the action.

Some Day.

There is a big field for endeavor in the problem of how to use the waste of the world.

The Western farmer wastes almost as much land as he cultivates. The price of his acres requires that he must cultivate fewer acres with less waste.

There is a great waste in human effort because "the round man gets in the square hole," and vice versa. A better system of education must find where men belong.

In a thousand ways we spoil almost as much as we make.

What a chance for the inventor's brain!

Some day the mighty force of the tides, now useless, will be harnessed and the power that is in them set to doing the work of men.

Some day the currents of air that wander idly over the earth's surface, doing no task save that of the turning of a few wind mills, will be tamed into submission and used.

Some day the heat of the sun, so prodigally distributed, will be made to warm the houses of men.

Some day the resident forces of electricity that lie latent will lift many a burden from the shoulders of men and women and little children.

Some day all these great forces will be stored up and ready to be released at the touch of a button.

These powers of nature overflow in wealth. By their surplus energy they give hint of their ability and their desire to help us in our tasks

succeed. It, therefore, seems fair to assume that a little sufficient preliminary precation in acquiring a necessary knowledge of the principle that assure success, the percentage of failures could be greatly reduced.

There was started, some time ago in Cleveland a public loan company, which was financed and managed by prominent men so that working people could obtain loans at reasonable rates and not be robbed by unscrupulous lenders.

Why could not an "Industrial Promotion Bureau" be formed by persons having ample means and a philanthropic tendency? This bureau would aid young men to gain a foothold in business, those having some funds of their own and needing a little more to make a proper start. The Bureau could have a secretary to supervise the formation of the company and the directing of the office work until the business was well on its feet. Interest could be charged for the use of the money so in the end that amount loaned could be passed to someone else.

It is the worry of having the financial end to watch that hampers many men of rare ability in manufacturing pursuits.

Latest Fuel-Saving Fallacy

So-called fuel saving compounds are exploited in the daily press with increasing frequency. For years these mixtures have been brought out and their tests advertised, indicating wonderful economy by increasing the efficiency of the coal pile. But one after another they have dropped out of sight. Much has been written and printed lately concerning such a compound, consisting of oxalic acid, common salt, water and ashes. Some manufacturers and other owners of power plants have become interested, to the amusement or disgust of chemists and engineers. If this compound is accomplishing what is claimed it would seem that perpetual motion, or its equivalent, has come at last. A compound almost devoid of carbon is introduced into coal, and more heat units are extracted than were put in. It does not seem to be a case of producing freer combustion, for the fuel is said to endure and to maintain a boiler pressure much longer than if coal were employed under ordinary conditions. It is not that a greater per cent of heat units reach the engine in the form of steam, but that there are more heat units to be divided between waste and applied power.

Water, composed of hydrogen and oxygen, decomposes when subjected to sufficient heat, as when mingled with coal, and the hydrogen with the assistance of the oxygen will burn, giving out heat units. But even under theoretically perfect conditions the burning hydrogen will produce only as much heat as was required in the decomposition of the water. If 64,800 calories were demanded of the coal in separating the two gases then the hydrogen will in theory give out just 64,800 calories, though as a matter of practice there would be material loss in the retransformation.

Much the same general condition exists when the new compound is introduced into the fuel. Neither water nor common salt contains carbon. The ashes have a slight residue of unconsumed fuel; the remainder is unburnable mineral salts, no more valuable for fuel than the dust from a stone crusher. The percentage of carbon in oxalic acid is very slight. In one reported test, where steam is said to have been maintained in a boiler for several hours with an extremely small amount of fuel, plus the compound, the amount of carbon in the acid was no greater than that contained in a piece of coal the size of a chestnut. A very small percentage of the mixture was carbon. The fire must have converted the chemicals into gases, burned those which are inflammable and increased the number of heat units in the process, which, as in the case of the water, is impossible, a loss ensuing instead of a gain. It is stated that clinkers are consumed. The chemist answers, "What of it?" The amount of heat required to consume the carbon remaining in a clinker is greater than the heat given out by the clinker in the process of its combustion. One practical man who made a test of the compound under a power boiler states that his fire was slow in starting, then blazed hotly and brilliantly, and finally quickly died down. The clinkers seem to have burned, but the ashes were as much in evidence as ever. Under such conditions heat which should have been given out evenly through a given period may have been generated practically all at once. The fire had to use its energies in decomposing the chemicals; then the gases blazed fiercely, with highly colored effects from the sodium, and soon died away. Common salt added to a hot fire seems to burn freely; yet it adds no heat, but rather colors the flames.

ritory, Viscount Hayashi boldly proclaimed Japan's intention to wage another kind of war.

"In matters of navigation, commerce and trade," he declared, "we are bound to expand ourselves in foreign countries, and will take necessary measures in the encouragement of the same. This strife is that of peace and virtue. No nation or people is without this heavenly endowed right."

So far as the navigation of the Pacific is concerned, the Japanese have already made great advances. Aided by subsidies and other government favors, the Japanese steamship companies have taken and are taking much of the Pacific trade away from American ships. Americans of long and extensive experience in navigation declare that unless American lines are aided by subsidies they must go to the wall. An American who is not interested in any shipping line, but who has for years vast experience in the Pacific trade, told me yesterday that the case is nearly hopeless.

"I don't see how we can take control of the carrying trade of the Pacific," he said. "The Japanese are crowding us out. They build and equip ships more cheaply than we can, and their cost of maintenance is much lower than ours—to say nothing of the direct help given by the government. Unless Congress shall grant generous subsidies our days on the Pacific are numbered. And if Japan should go to war at any time, and draw off her ships in the Pacific trade for use as transports, etc., our Far-Eastern commerce would be badly crippled."—Wm. Inglis in *Harper's Weekly*.

The Brennan Gyroscope.

Were it not for the fact that its inventor bears a distinguished name, and that the exploitation of the device occupied two hours of the time of the last meeting of the Royal Society in London, the Brennan gyroscopic locomotive would deserve no further notice than is usually given to any interesting scientific toy. At the present writing, indeed, it cannot be regarded as having demonstrated its practical value, at least as applied to heavy trains of the kind that are now running on the railroad systems of the world. The model locomotive exhibited before the Society was only six feet long, and, judging from the illustrations, it must have been of rather light construction. It is not safe to argue that because in this small size the invention is operative, therefore it would be operative if built to the greater dimensions and enormously greater weight of a full-sized railroad train. We should be prepared to find that the weight and power of the gyroscopes would quickly increase to a point where they would be prohibitive. That is to say, the apparatus would be so bulky and heavy, and would make such considerable demands upon the available power, as to render the construction and operation of a train of standard size commercially impracticable.

From a study of the illustrations it will be seen that the locomotive consists of a long, shallow body, carried on a pair of two-wheeled motor trucks, one at each end of the car. It is driven by two electric motors, mounted one above the outer wheel of each truck, the power being transmitted by gears inclosed in gear cases, one on each side of the driving wheels. All four wheels act as drivers, power being transmitted to the inner wheels by means of outside coupling rods, similar to those used on the steam locomotive. The gear case and motors are clearly shown in the photographs. At each end of the car and mounted centrally above the swiveling trucks is a pneumatic brake cylinder, and above each cylinder is mounted a hand-wheel, which engages a threaded extension of the piston rod, and is adapted to be used in case of a failure of the pneumatic brake. In the model shown, there

The gyroscopic top which shows the principle on which Mr. Brennan keeps his monorail car balanced on one line.

The Brennan Car, balanced by means of its gyroscope, traveling along a wire rope.

in order to insure easy climbing of the more precipitous ascents, the speed is only seven miles per hour; but this factor can be modified to meet any conditions.

The evolution of this invention is the result of some thirty years' continual experiments, though the present model railway and its equipment has been completed for more than two years. Publicity of the invention has been delayed in deference to the requests of the British and Indian governments, both of whicl have financed the experiments to a certain ex tent. It is possible that it will be given a tria on light railroads in India, where railroa construction, owing to the mountainous natur of the country, especially in the northern terri tories, is beset with numerous engineering dif ficulties rendering construction highly expen sive.—Scientific American. Photos from Scier tic American also.

awarded the Union Iron Works Company, of San Francisco, for the sum of $250,000. Large as this sum is it represents only a small part of the actual loss sustained by the steamship company.

For every day the giant liner remains in the dry dock it costs the steamship company one thousand dollars. This is not included in the contract price to make necessary repairs. It is estimated that the huge vessel will be in the dry dock for nearly four months.

She will not be ready to again enter active commission before July, and will have been idle—earning nothing whatever for her owners —for over eight months. This alone will be a heavy loss.

The Union Iron Works Company have nearly 1,000 men at work on the "Manchuria," and everything is being rushed forward with all possible haste. The total length of the "Manchuria" is 616 feet. With the exception of Jim Hill's monster vessels, the Dakota and Minnesota, she is the largest freight liner in the world. The Manchuria cost originally about $2,000,000; her total insurance on vessel and cargo (she was carrying a valuable cargo for the Orient when she stranded), was only $750,000.

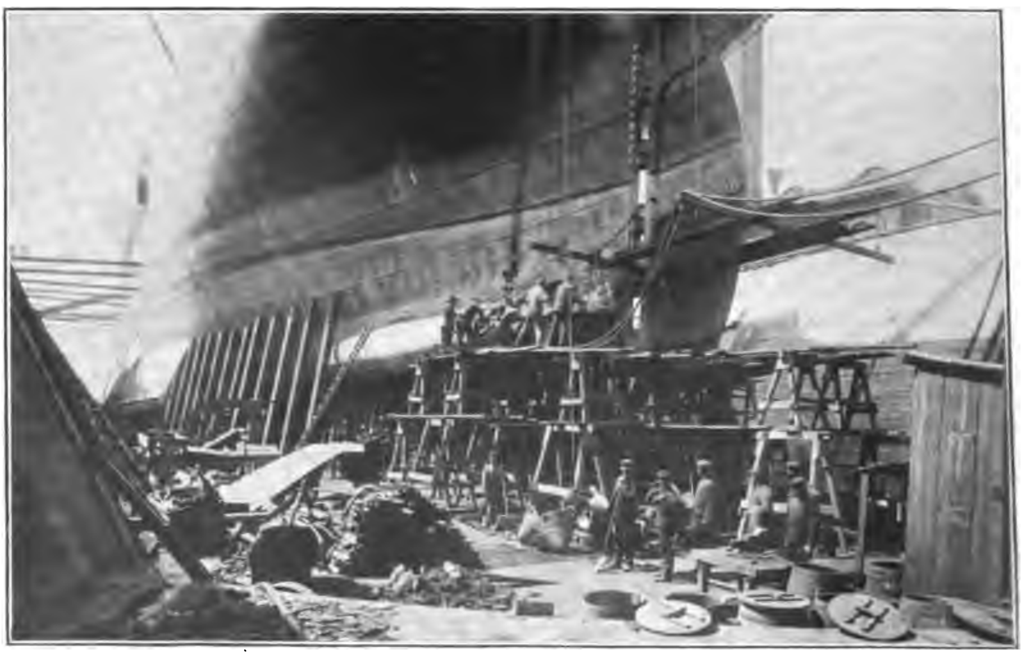
Even after coming out of the dry dock, a great deal of work will be necessary before the vessel will enter active service again. The purpose of the company is to make this giant liner as staunch and seaworthy as when new. She was launched about three years ago.

This photo shows the engineers engaged in placing in proper position one of the ponderous tail shafts of the propeller. The Manchuria has twin screws, as may be seen. The total loss to the company, including everything, will approximate $1,500,000.

All the light ships on the Pacific coast are soon to be equipped with the new system of submarine telephones, by the use of which it will be possible for the men on the lightships to exchange signals with incoming steamers at a distance of from 10 to 15 miles.

The record of last year's Pacific coast marine disasters shows that the greatest danger of mariners is attendant upon the attempt to make port in a heavy fog. Some of the largest liners plying in the Pacific are included in the list of the vessels that have gone aground.

Recently, a contract was entered into between the United States Lighthouse Board and the Submarine Signal Company, of Boston, for the early equipment of all the light ships on the Pacific coast.



Placing tail shafts on the propellors of the Manchuria.

ican-Hawaiian Steamship Company on the first of the present year.

The former route of the steamers between San Francisco and New York was by way of the Straits of Magellan, but, since the completion of the railroad by the Mexican government, across the Tehauntepec Isthmus, a distance of 184 miles, the American-Hawaiian Steamship Company has entered into a contract with the Mexican railroad commencing January 1, 1907, and to be continued until the completion of the Panama Canal, whereby the freight of this line will be by that route. The line will ply from San Francisco and Puget Sound to the Hawaiian Islands and then to Salina Cruz, Tehauntepec, the terminus of the railroad on the Pacific side of Mexico.

This shows the big "Mexican" on the ways just a few days before the launching.

At that point, the freight will be transferred to cars, and a day's run will land it on board the company's steamers at Coatzacoalcos, the eastern terminus on the Gulf of Mexico. This new route of the line will be nearly 9,000 miles less, and it is expected that freight will be carried between New York and San Francisco in as quick time as the transcontinental railroads do at present.

A large amount of business that is now done by the Panama route will undoubtedly be transferred to the American-Hawaiian Steamship Company. This company also own a small fleet of steamers besides the three new ones already mentioned, several of which will likewise ply on the lately established Tehauntepec-Isthmian line. The inauguration of this new route is one of the most important movements—commercially and otherwise—that has occurred on the Pacific Coast for the past quarter of a century.

San Francisco, Cal., is soon to have the largest dry dock ever built in the history of the world, so far as known. This new dock will be 1,050 feet long, 36.5 depth over the sill, and be nearly 200 feet wide at the top. It will be located at Hunter's Point, at South San Francisco water front. The monster new dock will be constructed and owned by the San Francisco Dry Dock Company. This company already own two docks at Hunter's Point—No. 1 492 feet long, and No. 2 750 feet long.

Plans are now being drawn for the new colossal basin by Engineer Howard G. Holmes and will be completed soon. Engineer Holmes drew the plans of the other two docks at Hunter's Point, and superintended the construction of both. He has also had personal charge of the building of a number of large floating docks in San Francisco harbor.

Although the company which will build and own the new dock is a private corporation, it is generally understood that the great work has been undertaken with the active and direct encouragement of the Secretary of the Navy, and that Department of the Government has also expressed a desire to have the colossal task carried forward to an early completion. Recently the Secretary of the Navy called for the plans of the two present Hunter's Point dry docks, and the drawings were made at once and forwarded to Washington. This may be regarded as a rather significant circumstance. Secrecy has sought to be maintained all along on the part of the government, but the matter has leaked out, and is generally known.

That the new dry dock (No. 3) will be the largest in the world is beyond all question. The following table will show the comparative dimensions and cost of the other great basins of the world:

The old canal extends west and south from Dresden through Newark to Lockbourne, but this part will not be used, thereby shortening the route. The mileage is 150 to Dresden and 155 from there to Marietta, making a total of 305 miles.

The incorporators of the new company are Martin Mendelson, M. Gelfand, Louis Mendelson, B. Zbornik, and H. E. Wertman, but these names are used in the incorporation to conceal those of the men who are furnishing the capital.

Under the present traffic conditions in Cleveland it is pointed out for the canal that a carload of freight could be loaded and delivered from here to Massillon via the canal under improved methods before a car of the same freight could be hauled by the railroads beyond the Cleveland terminals. The trouble is entirely due to a congested condition which has grown gradually for the past seven years.

It is the plan now to have a canal terminal along the river front and to tow freight from the canal into the heart of the city. The boats to be secured will have 150,000 capacity as against 75,000 of the old style.

Turbo - Electric Engines for Ships?

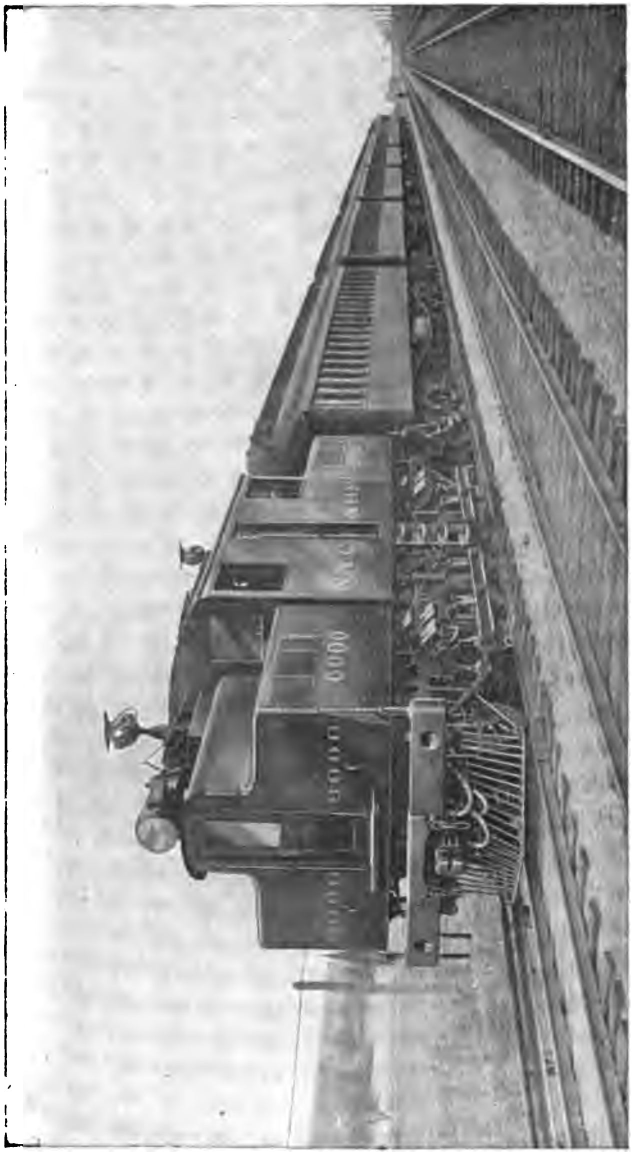
THE reciprocating steam engine has apparently reached the limit of its efficiency in the propulsion of ocean-going ships. The present indications are that the marine engine of the future will be either the steam turbine or the perfected producer-gas engine; with a strong probability that the latter, because of its excellent fuel economy, will be the preferred type.

There is, however, a third system of propulsion which theoretically, at least, has so much to recommend it that we should not be surprised to see it given a trial in one of the larger ships. We refer to the use of a turbo-electric plant of the same general character as that which is giving such excellent service in stationary power houses ashore. As installed in the engine room of a large steamship the system would consist of steam turbines, direct-connected to electric generators, the current from which would operate motors directly coupled upon the propeller shafts. Although at the first blush this looks like a complication of parts, the advantages derived in the increased efficiency both of the turbines and the propellers, to say nothing of other gains, would under certain conditions render such a plant superior to the present direct turbine drive. This will be evident from the following considerations:

If the turbines on an ocean liner are run at the high speed of revolution which gives the best steam efficiency, this speed will be too great for the propellers. On the other hand, there is a certain maximum speed, beyond which propellers suitable to the propulsion of a large ship cannot be driven efficiently. From the horns of this dilemma the naval architect has sought escape by the only road open to him—that of compromise. Consequently, in the largest turbine-propelled ships of to-day, the turbines are too large and heavy and too slow, and the propellers are too small and running too fast to give their respective best results.

The conflicting requirements of the turbine and the propeller may be harmonized by the interposition between them of the electric generator. This can be done by using small, high-speed, steam turbines direct-connected to generators, these turbo-generators being run at the speed which gives the most economical results. From the generators, current would be led to motors, whose type and speed of revolution would be accommodated to the propellers on the outboard end of the respective shafts. It is evident that by this arrangement both at the steam end and the propeller end the designer would have a perfectly free hand, and in shape, size, speed, etc., he would be able to design directly for the work to be done and, therefore, for the highest efficiency results. Of course, in a plant of this kind there would be a certain loss in the conversion from steam to electric power; but this has been reduced to such a low figure, that it would be more than offset by the increased efficiency of the turbines and propellers and by the great reduction in the sizes and weights of the turbines.

Incidentally there would be various valuable advantages secured. It would be possible, in the case of warships, to cruise at low speed economically, and it would be no longer necessary to provide separate cruising turbines. It would be possible to reverse immediately; and the go-astern turbines would, therefore, also be eliminated. Furthermore, the steam turbines could be located quite independently of the position of the propeller shafts, and might be carried on an upper deck immediately above



Third Rail System, New York Central Lines. Capacity 7 Pullmans at 70 miles an hour.

Cal. Following this period there was unusual activity in electric railroading. At this same time Van Depoele installed a small system at the Toronto Exposition employing an overhead wire. Soon afterwards similar experiments were made in Windsor, Canada; Appleton, Wisconsin; Port Huron, Mich.; Scranton, Pa., and Montgomery, Ala.

Look backwards to 1830 and we find the primitive age of steam roads. During the first thirty-five years the experiments in steam transportation made less advancement than have the electric roads for a correspondingly less period. The first steam road was but sixteen miles long and the first locomotive was christened "Tom Thumb." The comparatively young man of today can well remember the old hand-brakes before the advent of "air," the old link and pin coupler before the innovation caused by the "M. C. B." equipment and when sleeping cars suggested by Pullman placed him in the list of candidates for the mad-house. Since that time the writer need not recount what has taken place. Then

than to drive to the average town, then wait the pleasure of the steam train, and get back the same day "if he can." He can turn his farm into a pasture except a few acres and make a good return producing milk, garden truck and small fruits which the electric cars will each day take to a ready market. The progressive farmer can in short keep in close touch with the great world around him and enjoy the broadening influences which always accompany more frequent intercourse with the people at large. This is always the result of cheap, convenient and rapid transportation. Healthful home life of the country can be maintained and the children will be more reconciled to living on the farm, instead of flocking to large centers of population.

There is more meaning in the above statements than can be expressed in mere words. Distant cities are uniting into one commercial community and the dividing line between city and country is fast fading away. The quick, convenient and cheap transportation is working a rapid and mighty change in the modes of life and thought, in the customs and achievements of the whole people.

A vast industry in itself, the interurban wonderfully quickens and promotes all other industries. The enormous demands it makes upon the car shops, steel mills, wire factories and motor works are but a small part of the industry it creates. The untold thousands who are afforded employment as motormen, conductors, linemen and office attaches represent but a fragment of the labor to which it has opened the way.

The electric road has made all markets more easily accessible. It brings all classes of labor closer together; it has developed tastes and wants that people have never before known. It educates and not only carries people to the marts of trade but makes them frequent buyers. No populated section is too remote for the interurban to reach and bring into close communication with trade centers. It builds up alike communities, villages and cities, and from no point of view is the electric o ad to be despised.—The Tradesman.

The United States is coining annually about $300,000,000 in gold; Great Britain, nearly $60,000,000; Australia a little more than Great Britain; France, about $35,000,000; Germany, about $25,000,000, and Japan more than $30,000,000.

Automatic Train Control.

THE Interstate Commerce Commission, in its last annual report to Congress, asked for an appropriation to enable it to test safety devices for railroads. The great number of collision accidents of late—one can hardly open a newspaper without seeing the headlines announcing another wreck—has compelled the attention of the government to the need of protecting the traveling public. The last accident bulletin issued showed that there had been in the preceding quarter of a year 3,672 railway accidents of all sorts, of which over one-half were collisions. Nearly twelve hundred persons were killed, and the appalling number of eighteen thousand injured. In view of the probability of the compulsory adoption of some system of train control, it is of interest to note what devices may come before the Interstate Commerce Commission for trial.

One of the most interesting of these has already been experimented with on a stretch of railroad near Washington, and the railroad officials who witnessed the test said that it was entirely successful. It is called the Born electric signal and brake. Briefly, it consists of two lights in the engine cab, one red to indicate trains approaching head on, and the other white to show a train approaching from the rear. The light being in the cab of the engine and in front of the engineer's eyes, it is impossible for him either to disregard it or miss seeing it on account of fog or smoke, which have been the causes of some of the worst disasters to railways.

The principle on which the system works is that the power of an electric current is proportional to the length of wire that it has to traverse. The tracks in this case are used for one wire and there is an inexpensive trolley wire running beside the track for the return current. In the cab of each locomotive is an electric motor to operate the safety device and the current furnished by the small dynamo is just half strong enough to work the motor. When two trains are approaching each other, however, they get double the power out of the dynamo, and at whatever distance the machine is set it begins to operate. If it is set for a mile, the lamps in the engine cabs commence to glow when the trains have just a mile of track and wire between them. If it is set for 100 yards, the system does not start to work till that limit is reached.

Illustrating the congestion of coal carriers at Duluth, the most serious in years, just at the opening of the season. Boats being held at lower ports for repairs and being rushed to the head of the lakes caused the congestion.

The bids were called for by 10 day circulars and is under the joint control of the Quartermaster Department and the Corps of Engineers.

The Southern Pacific Railroad Company will very soon commence the construction of a giant oil-pipe line which will require the total expenditure of about $2,000,000. This gigantic project involves the building of an oil conduit from the oil fields of Kern county, to San Francisco. It will be 265 miles long and will consist of an 8-inch pipe (diameter) for the entire distance.

This will be the first railroad company in the world to own and operate its own oil pipe line. The line is intended to supply the company's hundreds of locomotives in California at a maximum cost. The railway company finds it impossible to buy or build enough tank cars to distribute oil at 200 or 300 points in the state to daily supply its engines.

On the 265-mile route there will be 23 pumping plants, each with two single or triple compound duplex oil pumps of special design; also two water pumps for injecting water to facilitate the flow of the oil through the pipe line from the wells to San Francisco. At each pumping station there will be a 750 horsepower battery of water tube boilers in three units; also two large steel tank reservoirs for storage purposes.

Negotiations for this giant project are now in progress in the East through President E. H. Harriman.

There is a little machine known as an Ejector, whose large field of usefulness is not yet appreciated by a great many users of steam. It is marvelously simple in construction, requires but a small amount of steam—far less than a steam pump—and on account of its compactness and portability, allowing it to be placed with little expense near the work to be done, is becoming a common substitute for steam pumps, syphons, etc.

It would be difficult to enumerate all the uses to which an ejector is adapted, but when we say that anything and everything in the nature of a liquid (if not too thick) can be transported from one level to another, or horizontally any reasonable distance, the ground is just about covered.

Take for instance such plants as Breweries, Chemical Houses and other concerns using heated liquids, the "XL—96" Ejector is indispensable and unrivaled in its simplicity of operation. It is also an unexcelled agency for raising liquids from wells, tanks, mines, vessel holds, docks, etc.

Distilleries, creameries, tanneries, dye works, paper mills and plants of like character employ them almost entirely for raising and syphon purposes.

Complete information as to the "XL—96" Ejector and its uses may be obtained by writing to the manufacturers, Penberthy Injector Company, Detroit, Mich.

The Electric Monorail Crane.

THE following illustration is of a Sprague Electric mono rail crane unloading structural steel at a manufacturing plant in Pennsylvania. The operator's cage, as will be seen from the illustration, is suspended from the hoist proper and carries two controllers, one for operating the traversing motor and the other for controlling the hoisting motor. The controllers are of the street railway type fitted with adjustable figures and removable contact plates and are designed for severe and continuous duty. The hoist motor has a steel frame, is series wound, and designed to handle this class of work. All motors and controllers are entirely enclosed, so that the hoist may be used out of doors without being provided with a housing or other protection from the weather.

The gearing between the hoisting drum and the motor is of triple reduction and of the spur type, the gears being of cast steel and the pinions of steel forgings. The entire transmission is enclosed by a gear case for protection from dust and moisture.

The hoist is equipped with a limit switch which may be set to stop the hook at any desired point within the limits of the hook travel and is also provided with a load brake in addition to the standard magnetic service brake, its operation being such that the load

A New Gasoline Motor Pump.

BY FRANK C. PERKINS.

THE accompanying illustration shows a new and interesting application of the modern gasoline motor in the form of a portable centrifugal pump suitable for drainage or irrigation and capable of dealing with water or sewage.

This combined petrol motor and centrifugal pump is of a balanced high efficiency type mounted upon a hand spring cart and constructed at Leeds, England, by Hathorn, Davey & Co., Ltd. The smallest equipment is designed for delivering 120 gallons per minute a height of 30 feet, the largest amount of water handled by the unique gasoline motor driven pumping equipment being 600 gallons of water per minute a height of 10 feet.

The suction pipe is 15 feet in length of the flexible armored type with foot valve and strainer, a metropolitan instantaneous union being provided for attachment to the delivery hose. It is stated that the lubricating oil and gasoline tanks are sufficiently large for a run of several hours without refilling and when charged this combined gasoline motor centrifugal pump can be started at a moment's notice and requires but little attention.

As noted in the illustration the motor and pump are entirely enclosed, a small crank, permanently connected for starting, projecting from the case, as in an automobile engine, being provided.

The first vessels constructed of iron were built in about 1830. The first steel vessel was the Rainbow, 170 tons, built in 1858, for the Niger expedition.

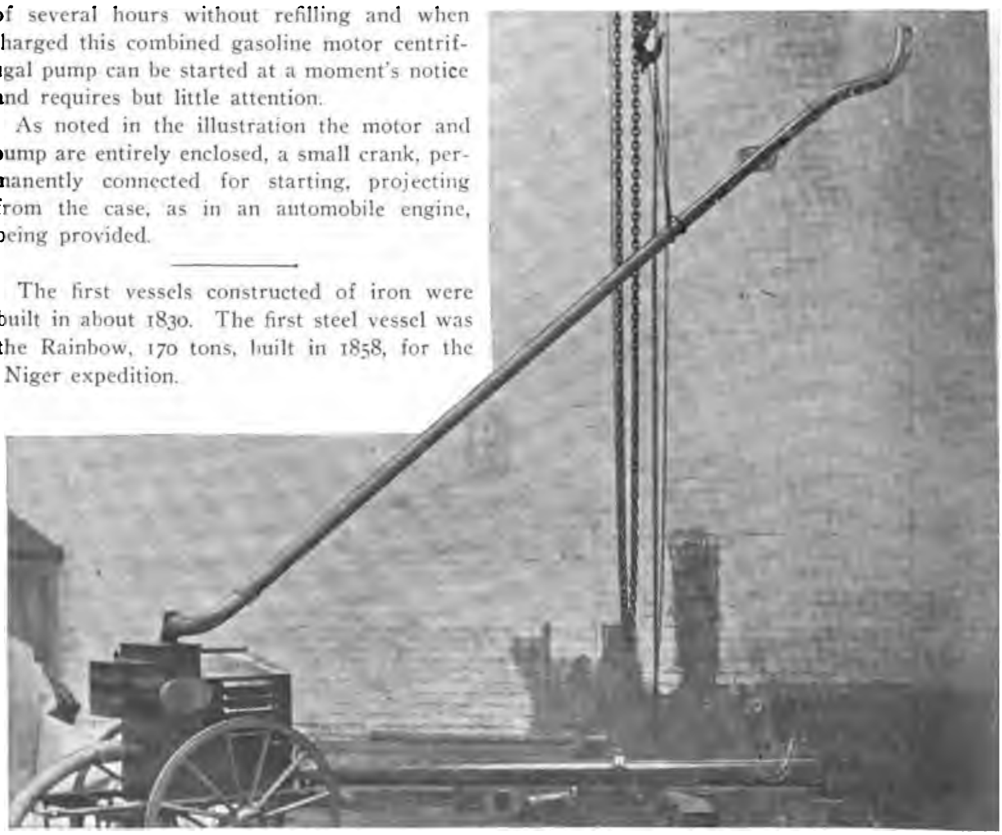
A Hold-Up.

A HOLD-UP of a city by a water works corporation was attempted at Salem, Ohio, the latter part of May.

The waterworks were owned by a Boston corporation which was seeking a new franchise at an increased rate. And for one night and half a day it exposed this city of 11,000 people to the danger of fire, its sick and its infants to death and its industries to ruin in order that the inhabitants might be brought to their knees and forced to grant a new franchise at a few more cents per 1,000 gallons.

The original company held a franchise for 20 years, then it fell into the hands of Boston men represented by a superintendent. The company declared it was making no money so offered to sell for $135,000, but that was considered too high.

The company offered to put in meters at 40 cents per 1,000 gallons, and there would be extra charges for hydrants, bathroom fixtures, etc.



States reclamation service; Gifford Pinchot, chief of the United States forestry service; M. O. Leighton of the United States geological survey, and Col. Clinton B. Sears of the Mississippi River commission were also in the party.

As the reclamation act stands today it applies practically to the reclamation of land by irrigation. By stretching the text of the act land might be reclaimed by drainage.

In its campaign for reclamation by drainage the St. Louis section of the National Immigration Association sets forth the following:

The present reclamation act applies to fourteen states and territories, viz.: Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington and Wyoming.

The $37,000,000 constituting the reclamation fund is the money of all the people and not the money of the fourteen states and territories.

If the reclamation of land by irrigation is constitutional and right, then the reclamation of land by drainage is equally so.

The land to be reclaimed by irrigation will give a great addition to the land values of the United States and to the crop values of this republic, but the land that can be reclaimed through drainage will add 50 per cent more per acre of land values and crop values to the republic than will irrigated lands.

The complete and perfect drainage of land on the west side of the Mississippi River in Missouri, Arkansas and Louisiana, and on the east side drain the lands in Illinois, Southern Kentucky, Western Tennessee and Mississippi would put into cultivation about 16,000,000 acres of the richest land in the world. This work, if done by the government, would be so small a cost on each acre of land that it would scarcely be felt. It would place on those lands a population in excess of what is now there, safely, of 3,000,000 people. It would quadruple the present value of that land. It would increase its productive capacity annually five times over.

It would invite to that territory the best class of the agricultural population to be secured from all countries and all sections.

It would greatly lessen the danger of overflow of the Mississippi River and give safety to homes and property to what is now not enjoyed.

It would increase the commerce of St. Louis, New Orleans, Memphis and every small city and town in all the contiguous territory.

It would make the Mississippi valley the richest agricultural section of the world. Of this vast territory St. Louis would naturally be the great manufacturing supply market.

Memphis would increase its trade enormously. It would make New Orleans four times a greater export and commercial city than it is.

The reclamation law provides for a fund to be made of the moneys received from the sale of public lands. The fund now reaches approximately $35,000,000.

The law provides when money is spent to reclaim land, the money so spent returns to the reclamation fund in ten annual payments, thus always increasing instead of diminishing the fund.

There are ten projects accepted by the government on which reservoirs will be built and canals dug.

There are twelve projects that have been approved by the secretary of the interior on which reservoirs will be built and canals dug at a late date.

The Jamestown Exposition.

THE Jamestown Ter-Centennial Exposition is on the shores of Hampton Roads, and covers 344 acres of land, formally known as Sewalls Point, which is 8 miles north from the City of Norfolk, and directly opposite Old Point Comfort, and where the James pours its waters in the Chesapeake Bay, with the broad Atlantic in the distance between the Virginia Capes.

The Exposition grounds can be reached by two electric lines of the Norfolk & Porthsmouth Traction Co. Cars marked Norfolk & Atlantic Terminal Co., also Bay Shore Terminal Co., now owned and operated by the Norfolk & Porthsmouth Traction Co., leaves City Hall Avenue in front of the Monticello Hotel at short intervals direct for the grounds. Cars on main line of the Norfolk & Porthsmouth Traction Co. leave West Main, corner of Granby Street for the Exposition grounds via Ocean View, also various steam boat lines from the many different wharfs to the piers adjacent to the Exposition grounds, and the various steam boat lines plying between Norfolk, Washington, D. C., Baltimore, Md.,

Industrial Progress at Coos Bay

ABOUT two-thirds the distance up the Pacific Coast from San Francisco to the Columbia River, the port of Portland, Ore., lies Coos Bay. Many inlets and small bays jet into the land along our western coast, but none possess so many natural advantages as Coos Bay.

Without harbors, there could be no ocean freight and a good harbor is one sought by the commerce for it, like force follows the lines of least resistance and it is commerce that builds every city. Trade and manufacturing are the industries that bring together a large population. A city's most valuable asset is a deep sea harbor. Cities were built at

The Southern Pacific Railroad building in from Drain is now almost to the Umpqua and before the end of the year 1907 it should be at Coos Bay. There is strong belief that other

Overland Stage as connection between Coos Bay and the outside world.

transcontinental railroads will make this fine harbor their Pacific terminus. Among the roads talked of for Coos Bay are the Hill line, Gould's line, the Burlington and the Rock Island.

The great export product of Coos Bay for fifty years has been lumber. The standing timber of Coos county alone is estimated at 27 billion feet and there is tributary to Coos Bay west of the Cascades a hundred billion feet.

Seventy-five per cent of this timber is the valuable fir, or Oregon Pine as it is called.

The Port Orford cedar, or white cedar, is known in scientific works as the Lawson Cypress. It is the most beautiful of ornamental trees and the most valuable wood for ship building. It is found only in Coos and Curry counties. The white cedar doors from North Bend are becoming celebrated.

One of the most beautiful woods for veneer furniture and panels is the myrtle. The veneer from the North Bend furniture factory at the Lewis and Clark fair was much noted.

Other Coos county forest trees are, alder, ash, maple, madrone, oak, spruce, hemlock, and red cedar.

There are now in operation in Coos county, or about ready to start, twelve sawmills whose capacity is more than a million feet per day.

The coal bearing area at Coos Bay covers four hundred square miles. It is estimated that there is 800 million tons of coal half of which can be mined. This is an excellent domestic coal and is good for steam and manufacturing purposes. The Beaver Hill and the Libby mines have been operated for years. Nearly all the coal land is in private ownership.

The city of Coos Bay will get its water supply from Clear Lake. This lake is 287 feet above the sea. On the west are the sand hills and there will not be vegetation enough to make that an objection. It is estimated that this lake with its four square miles of watershed will supply a city of 300,000 people.

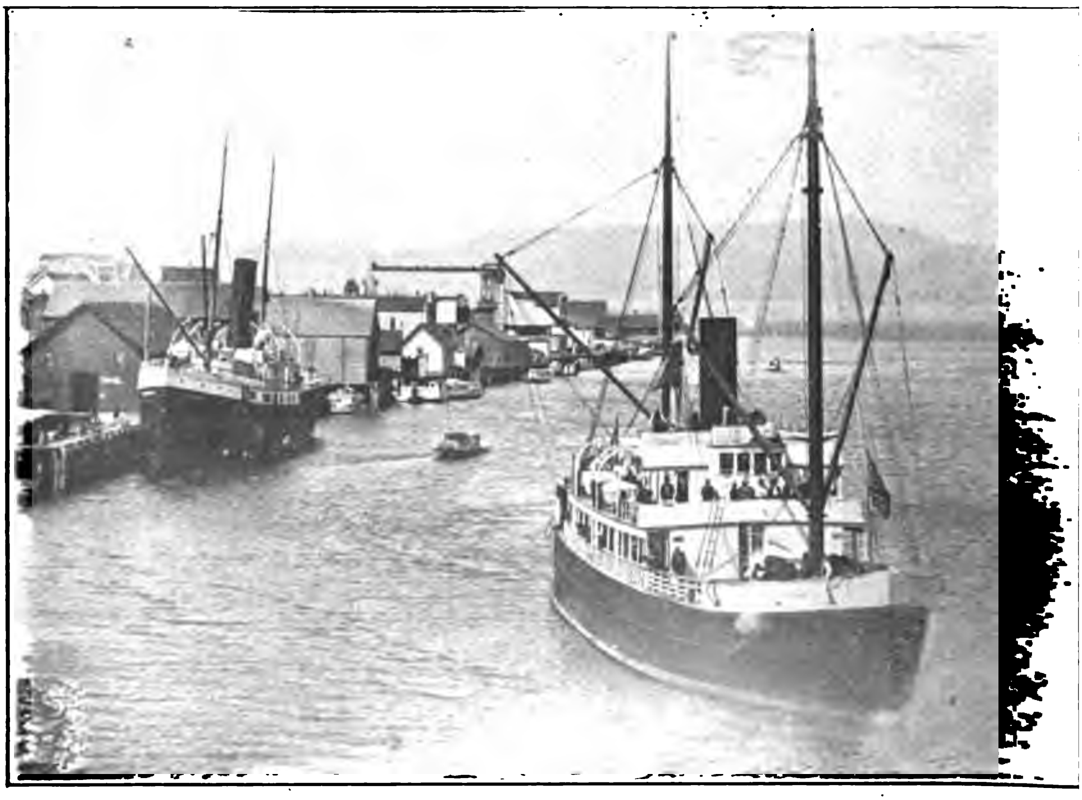
It is apparent at once from a glance at the map that Coos Bay possesses a great advantage in its water front. It is estimated that within a radius of five miles from the center of the peninsula a hundred miles of wharfage is available. In addition the lakes, inlets and rivers are navigable beyond this limit. Boats go up either fork of Coos River for a distance of ten miles. The Coquille River is navigable for forty miles. Some day a canal will be cut through the isthmus and steamers will pass from the Coquille directly through to Coos Bay. The government made a survey for such a canal in 1873 and the estimated cost at the high prices then prevailing was $350,000.

Coos Bay spreads out its arms like a great octopus, and on these arms ply the gasolene launches, the family carriage in this country. Mr. Clarke has called it the Venice of the West. And each of these inlets when dyked makes available the best of farming land.

Coos Bay is not without its gold and mineral belt. There is iron enough in the black


WESTERN
OREGON
PACIFIC OCEAN
COLUMBIA RIVER
CLATSOP
COLUMBIA
WASHINGTON
PORTLAND
MULTNOMAH
TILLAMOOK
YAMHILL
WOODBURN
CLACKAMAS
WASCO
MT HOOD
POLK
SALEM
MARION
LINCOLN
ALBANY
CORVALLIS
BENTON
LINN
CROOK
LANE
EUGENE
COTTAGE GROVE
OREGON EASTERN
DRAIN
DOUGLAS
COOS BAY
NORTH BEND
MARSHFIELD
ROSEBURG
COQUILLE
MYRTLE POINT
CRATER LAKE
KLAMATH MARSH
CURRY
JACKSON
GRANTS PASS
MEDFORD
KLAMATH
JOSEPHINE
ASHLAND
KLAMATH FALLS

A View of the City of Marshfield.



Water Front, Marshfield, Oregon.

A Steamer crossing the Bar going into Coos Bay.

San Francisco and Seattle not because the sites were ideal, but for the reason of the fine harbors. It has cost $200,000,000 to dig out the harbor of Liverpool, more than the price of a transcontinental railway from ocean to ocean, and it has been a paying investment. Nature has produced a harbor in the Oregon Coast which needs little to make it second to none on the Pacific.

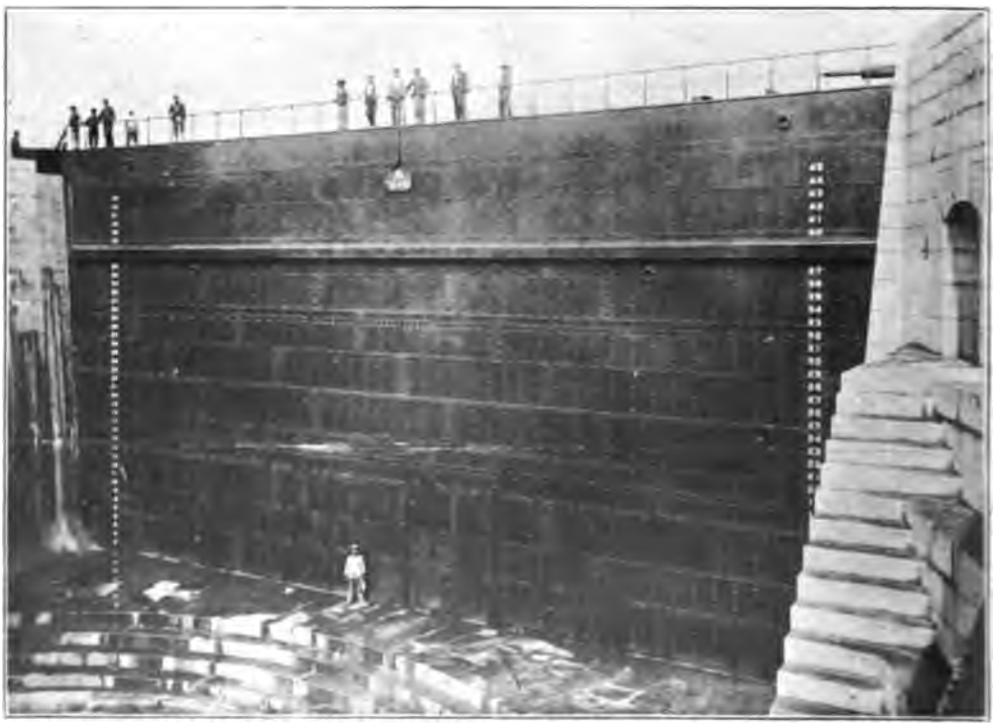
Coos Bay, as shown on the map, curves back in the shape of a horse shoe with a small mouth, but increasing in width in the interior, the upper bay b ing 2½ mi'es at the wi'est part.

Congress has ordered a new survey to aid work already begun and a depth of forty feet at low tide will, no doubt, be obtained at the mouth of Coos Bay. The existing plan calls for a depth of 20 feet and it was estimated that it would cost $2,466,412.20. That was in 1890 and there has been spent $619,987.13, of which $166,987.13 has been for maintenance and there is 24 feet of water.

Two main cities have been established, North Bend and Marshfield, the former is less than five years old and boasts of 2,000 sou's.

Water Front of North Bend, Oregon.

The Steel Canal is placed on top of the ground and packed under with earth.



Masonry around the service reservoir supplying the canal.

night as well as day. Although there was considerable trouble with the men, owing to continual petty warfare between the various tribes of Arabs, the entire pipe line was completed with only one fatality, that one being due to sunstroke. The average temperature under which this work was carried on was over 110 degrees in the shade.—Ryerson's Monthly.

The above is a reproduction of the souvenir pin tray presented by the Atlas Engine Co. to the members of the American Society of Mechanical Engineers who visited their plant during the convention at Indianapolis, Ind.

The fact which impressed the writer most was that the Atlas Engine Co. carries 20 engines of each kind in stock, so that orders may be filled immediately. The same is true of the boiler works.

Camera Man for Unions.

The traditional "walking delegate" has been replaced by an artistic person carrying a "snapshot" camera under his arm.

The "camera delegate" is a combination of "walking delegate" and photographer, whose duty is to take pictures of buildings under construction.

Sufficient data will be gathered in connection with the pictures to enable the union officials thus to keep track of the building industry from day to day.

The rails of the Belt Line Railroad in Philadelphia are the heaviest in the world.

The Museum of Safety Devices.

WARWICK S. CARPENTER.

THE Museum of Safety Devices and Industrial Hygiene has announced that the Scientific American through a desire to co-operate with the work of the American Institute of Social Service in establishing an American Museum of Safety Devices, will give annually a gold medal to be awarded by the Institute for the best device for the safeguarding of life and limb. This announcement follows as a direct result of the exposition of Safety Devices and Industrial Hygiene which was given by the Institute from January 23rd to February 12th, and which was described in the Industrial Magazine for May.

The medal will be awarded by a committee of nine experts to be appointed by the Executive Committee. The Scientific American has attached no conditions whatever to the award. Such regulations as are imposed will, therefore, be for the purpose of insuring fairness in selecting the most meritorious device. It has been suggested by the Advisory Committee of the Museum that the field be limited each year to some particular industry, such as railroading, the textile industry, the steel industry, the electrical field, navigation, or others of equal or broader scope. Otherwise two equally valuable devices might appear at the same time in different fields and it would be unfair to select one and reject the other. This method will probably be adopted and the fields will be made broad enough to cover the whole range of human activities within a reasonable time.

Another gold medal has been offered by Mr. Francis H. Richards, to be awarded annually by the Institute for the best invention for safeguarding life, to be exhibited at the Institute, for automobiles and motor boats. A committee of three known as the Richard's Medal Committee will have charge of this matter, and it has been recommended by the Advisory Committee that one member of it be the President of the Automobile Club of America.

It has recently been announced that Dr. L. L. Seaman, who accompanied the Japanese army on its campaigns, and who made a careful study of hygienic and surgical methods employed there, has offered an annual prize of $100 for the best essay on the subject of in-

Packing Room of a Soap Factory at Port Sunlight, Eng., showing cleanliness.

to maintain such restrictions on the property as shall be necessary to this end.

Already five different movements to build Garden Cities in as many States have been endorsed. The exact locations cannot be made public at present, however, as not all of the land has been secured, and it would be immediately seized by speculators. The five propositions to which support has been given are on Long Island, in Virginia, in Pennsylvania, in Connecticut and in New Jersey. On Long Island 800 acres are to be developed into a model industrial village, consisting of factories and the homes of the workers. One factory has already agreed to move onto the land, and arrangements for others are now in progress. The Virginia proposition is the largest, and provides for the development of 5,000 acres, mainly as an agricultural community. In Pennsylvania, near Easton, 500 acres are to be developed for manufacturing and residential purposes, the work of finding factories to take some of the land being now well under way. 247 acres are to be developed in Connecticut, near an industrial city, and 1,000 acres will be improved in New Jersey within 31 minutes of New York. The latter is by far the most important of all, as within a twenty mile radius of the spot selected there are 8,000,000 inhabitants, many of them crowded together in very unhealthful surroundings. In the last two cases it will not be necessary to wait for factories to be built, as the industrial population to people these Garden Cities is immediately available without any change of present places of employment. In every instance the good points found in the most successful undertakings of the kind abroad will be followed.

The Association will shortly be in a position to locate 375,000 families. 650 acres are to be developed immediately. $400,000 in money and land has already been subscribed and things are actively under way to carry out the plans.

The Association has abundant material on which to work, while from England and the Continent it can gather many suggestions which will be of great practical advantage in solving the special problems which this country presents. In France, at Noisiel-sur-Seine, M. Menier, the chocolate manufacturer, has erected since 1874 a city of over 300 semi-detached brick cottages with tiled roofs, so

This is the first of a series by Mr. Carpenter on Industrial Betterment.

One of the Villages built for Krupp employes at Essen, Germany.

arranged along the streets that each pair stand opposite the garden of their neighbors. These houses are specially designed for the needs of the tenant and rent for a sum which is from a tenth to a twelfth of the income of the householders. This is very different from the fourth to a third which workers in large and crowded cities in America must pay for much poorer accommodations.

There are many other model industrial villages in France, and almost all of the large European countries where congestion has been felt, have taken active steps to relieve it. In the United States a good deal has been done, but there has heretofore been no systematic and organized movement to obtain the best ideas and utilize them. Perhaps the best example for this country to follow is that of Letchworth, England. That city is laid out with ample provision for gardens and parks. Tall trees are planted to screen the factories, and hedges are used instead of fences. All buildings have to be approved by the official surveyor and must conform to certain specified requirements. Extensive waterworks and other public utilities are provided. Land is leased for ninety-nine years at a fixed ground rent, or for 999 years at a periodically revised rent, which must yield an income of not over 5 per cent. The intention is ultimately to hand over the estate to trustees, either on behalf of the shareholders, or of the community if it decides to buy the shareholders out.

The European method of establishing Garden Cities is primarily paternalistic. Perhaps the best example of this is the Krupp village, at Essen, where all of the houses, hotels, and the hospital, are owned by the Krupps and rented for a moderate amount. The American movement, however, is intended to be co-operative so that workmen can own their own homes if they wish. It is not planned, either, to introduce pure philanthropy into the undertaking. A workman who is earning his own living is not a subject for charity. But it is recognized that the industrial housing situation is far from satisfactory, and that an organized campaign is required to remedy it, to provide proper dwellings, and put them within the reach of workmen at a reasonable price.

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and to bring up samples of the material encountered. Quick and approximate results were desired. It was easy to sink a pipe by means of a jet of water into the ground, but it was another matter to get the samples. The pipe had a reducer and nipple at the end of a valve, which could be removed easily while sinking and put in place when sampling was desired. One of the men suggested the use of a large marble which could be dropped down the pipe when the proper depth had been reached and removed with the sample when the pipe was withdrawn. The entire stock of suitable marbles in the little town was bought that night for one cent each, and for a week a single marble did the work admirably.

The conditions to be met must be carefully weighed, and while we should provide for all reasonable contingencies, it is often better engineering to the neglect of trivial things which may be possible, but either not probable or not troublesome, and let time take care of them, than to spend a lot of money in guarding against them in advance.

I have in mind a bridge in which an approach span was founded at the bank end on a block of concrete placed on top of a newly made embankment fifty feet high. The bank of course settled, very rapidly at first and less so as time went on. In the fifteenth year of its existence this span settled one inch at the bank end against several feet the first year. The engineer in charge in this fifteenth year criticised his predecessors' design of the foundation, saying it should have been carried to rock, which was about 120 feet below the rail, so that this settlement of one inch might have been avoided. The cost of such a solid foundation would have reached $100,000, if not more, whereas the existing foundation plus maintenance for the fifteen years was only a small part of that sum. Furthermore, the yielding of the foundation with the settlement of the bank made the approach span a self-adjusting incline requiring infrequent attention, while the solid foundation would have had no such elasticity and would have required daily attention to keep the track supported as the bank settled.

It is perfectly proper to design each floor of a high building for a maximum load, but it would be a waste of money to design the lower story columns for the sum of all these heavy loads.

Reasonable allowances should be made for future developments, but we are seldom justified in looking ahead more than twenty or thirty years, for changes come so rapidly that the uses for which a structure is erected today may demand entirely different accommodations in a generation. Few of our iron bridges have served for thirty years, and some notable early steel bridges have been renewed in a little over twenty years. These bridges as a rule did not wear or rust out, but the loading increased with such marvelous rapidity that they could not safely sustain the heavier loads to which they were liable to be subjected. Steel frame office buildings date back scarcely a quarter of a century, yet some of them are being taken down to make room for higher or more convenient structures. As for mill buildings, the duration is still more uncertain, though the life of either might have been indefinite under original conditions.

Many of our great, magnificent railroads could not have been built when they were, and the new country would have been undeveloped for many more years, had the designing engineer spent any money not absolutely necessary for immediate uses. As it was, capital required abundance of faith when it was invested, in building as cheaply as possible the pioneer railroads of the great West, which paid no dividends for years but are now yielding a rich harvest. And who will say that because a community has not enough money to build a bridge to carry 100 pounds to the square foot, it must continue to ford the stream rather than build a 60-pound bridge which it could pay for.

We can afford to pay 50 per cent more for a structure that will last just thirty years than we can for two structures that will last just 15 years. $1,000 saved on a structure is worth, at five per cent interest, $4,320 towards renewals in thirty years.

In work involving articles of well-established lines of manufacture, or the use of equally tried processes, it is always advantageous to consult freely with the manufacturer's or contractor's engineers. Such men have probably encountered the problem to be solved, in some form or other, many times to our one, know its difficulties, weaknesses and anomalies, and have eliminated many fallacies that look good to the eye but are largely illusions. They know also what their machinery can do well and cheaply, and what it

to know what is odd one must keep in close touch with mill practice.

The above is particularly applicable to minor fittings such as brackets and shelf angles, stiffeners and the like, the size of which depends less on stress requirements than on other practical considerations.

The calculations of rivets and pins are based on eminently safe theory, but it can hardly be called correct theory except so far as it is safe. When, therefore, connections of six or more rivets differ from each other theoretically by one rivet, or say 15 per cent, we need not hesitate to make them alike. Floor beams have been known in railroad service to have flange rivets spaced 15 inches centers throughout their whole length and not fail. These floorbeams were improved by adding twice the original number of rivets, thus making 5-inch spaces, which was theoretically not enough, but the engineer argued correctly that if 15-inch spacing did the work 5-inch spacing surely would. There have been other floorbeams, I beams with cover plates, doing good service with no rivets connecting cover plates and beams between stringer bearings, which, of course, is theoretically correct.

Similar reasoning can be applied to diameters of pins. In two important bridges the pins, figured by standard rules for bending, were subjected to fibre stresses as high as 250,000 pounds per square inch and yet were perfectly straight and sound.

I do not advocate changing pin and rivet theories, but merely wish to point out that some latitude is permissible.

Duplication of parts saves both time and money directly, and it pays well to have the draftsman study these matters carefully and thereby save the time of many men in shop and field.

Close fits and fine finishes, where not required for direct service or appearance in conspicuous places, are expensive and to be avoided. There is nothing more annoying to the erector than tight fits in field joints, requiring heavy hammering to get them together.

The making of specifications by the assistance of scissors is not uncommon and has some commendable features, but it should be done intelligently and a waste basket should be at hand as well as a glue pot. Results should be aimed at rather than processes, unless it is important to eliminate known bad practices. It is better to say in such cases what shall not be done rather than what shall be, as the contractor may have ideas of methods that are superior.

A prominent engineer once gave the two objects of specifications to be, to describe the results desired, and to keep the contractor from wasting time on trying to make cheap but doubtful material and methods, fill the requirements. Specifications should cover every point of importance clearly, but they should be as concise as possible. It would hardly seem necessary to say that cement shall be delivered at the site in manila paper bags containing about 80 pounds each and tied with hemp strings, when such a proceeding is common practice and wholly immaterial.

When the contract for work has been let, the end is not yet. The work must be made to plans and specifications and requires the eternal vigilance of the inspector. It has been said that no contractor can be trusted to do an honest piece of work. As I am in the service of a contracting corporation, it is of no avail for me to argue the point, except, that while practicing as an engineer I met many honorable contractors and it is my experience that confidence begets confidence, while suspicion creates antagonism and trouble.

It may be pertinent to point out a few features of the relations between the engineer and contractor. The contract specifies what each party is to do, and though the engineer is usually made the arbitrator of all disputes, and the contract gives him many arbitrary rights, this does not warrant him in exacting anything not distinctly agreed upon or reasonably implied, or in making changes without corresponding consideration to the contractor in money or time.

To the credit of most engineers it must be said that they are fair-minded, and if they will put themselves in the contractor's place and be fair, they are pretty sure to get a square deal.

To come back to the inspector, who deserves much consideration for the trying position he is in. He should be a man of experience, though frequently he has just graduated from college and knows about what all of us did at that stage of our career. An experienced inspector should be given plenty of discretion as to how he enforces his specifications. A wilful violation of course cannot be tolerated,

investment of considerable capital by contractors, which the government could itself furnish much cheaper and hence the contract was withdrawn rather than pay the price. Whether this is true or not in the Panama Canal case is immaterial; it illustrates, however, that requirements may easily be made of contractors, against which the latter must protect themselves, which the purchaser has to pay for ultimately without getting much in in return. Penalty clauses and guarantees are frequently of this boomerang variety. A case in point is the following:

The government let a piece of work and stipulated that ten per cent of the purchase price should be retained for ten years as a guarantee for the durability of the work for that period. The contractor figured his cost plus a fair profit, then added the amount to be retained and this sum constituted his bid. He executed the work, made his profit out of current payments, and at the end of ten years collected his guarantee fund with interest as an extra profit.

The whole subject was admirably covered in a brief letter by the Chief Engineer of an important railroad who said: "We want as good bridges as any one and don't want to pay a cent more than they are worth and if there is anything in our requirements that adds to the cost without producing corresponding value, please point it out to us."

Others are making inquiries along the same line although the question is not so concisely put, and still others have mastered the problem and are getting good work, in quick time at a minimum cost.

What has been said may be criticised as a recommendation to accept mediocrity in engineering structures and looseness in business methods. It is not so intended, but rather to point out some of the things that have to be paid for in the long run, which are frequently not worth what they cost. The fundamental principle of all business is common sense, and the engineer who has plenty of this and is alive to the commercial side of his problem, as well as the technical side, will know where to draw the line between what is worth paying for and what is not, and will be able *to direct the great sources of power in Nature for the use and convenience of man in the most economical manner consistent with the object in view.*

A locomotive requires 100 gallons of oil a year to keep it running smoothly.

Steel vs. Wood.

Prices of Steel Beams and Southern Pine Compared.

THE curves plotted in the accompanying diagram show the fluctuations in the prices of steel beams and Southern pine timber over a period of years. They bring out strongly the advance in the price of lumber, its resistance to unfavorable conditions of business and its quick response to favorable conditions. They demonstrate that already steel is cheaper than wood for structural purposes where heavy loads must be sustained, and that if the constant, never receding advance of pine is to continue, as lumbermen confidently predict it must, the time is not far distant when steel will be the cheaper for all buildings requiring the strength that makes desirable the use of one or the other of the two materials. Reinforced concrete must be given an important place in connection with this class of construction, but the experience of those who have used it has varied so materially as to cost and its use is so comparatively young, that the price of steel beams is the better as a basis of comparison with the timber.

The two curves are, strictly speaking, relative. That of beams, based on Philadelphia quotations, is taken from the diagram published in The Iron Age of January 10, showing the fluctuations of prices of crude and finished iron and steel. The price of Southern pine is plotted from the "general run of the yard" price, wholesale, at Boston, Mass., compiled from weekly quotations. The one price is cost per ton, the other cost per 1,000 ft. The run of the yard price means that of timber large and small. The larger sizes bring the greater money per 1000 ft. If data could be procured to plot a curve of the price of some one heavy size of timber, the extremes between the two ends of the curve would be even more marked, for the larger sizes have advanced more rapidly than the smaller, as must be the case in the face of a dwindling supply and a growing demand. For the general comparison of the two materials, timber and steel, the prices used in the curves afford the fairer basis. In a sense, the prices of other kinds of lumber have followed that of Southern pine, but the average increase has not been fully as marked.

means $55 per 1000 ft. erected, or $41.03 for the equivalent of the steel. Thus the steel has more than $2 the better in the comparison.

Taking the same distance between posts and the same span, but reducing the load to that of the next smaller standard size of steel beam, 15 in. 42 lb. supporting 157 lb. per sq. ft., it is found that the cost of the steel is $25.20, as compared to the $20.52 for the equivalent timber—a 14 x 16 in. girder.

In October and November, 1904, steel beams dropped to a point where they were cheaper than Southern pine, in about the same ratio as that of today, for heavy loads. The market was depressed, while timber remained stationary. When steel drops again; if timber retains its present tendency to maintain its price regardless of general conditions, the advantage will be even more marked than now, especially if pine shall have continued its step-like progress upward. Taking everything into consideration, including the expert opinion of men well informed in the lumber business, there would seem to be little doubt that the tendency will constantly increase to substitute steel for mill construction, not only because of the merit of steel as a building material but because of a lessening comparative cost.—*Iron Age.*

Cost of Maintaining Arc Lamps

In view of the present interest in cost of maintenance of various electric illuminants the following figures on the cost of maintaining arc lamps will be of interest as giving specific data from commercial practice. These figures are furnished by the courtesy of R. E. Richardson, general manager of the Kansas City Electric Light Co.

Cost per month per lamp—

Trimming	$0.1110
Carbons	.0693
Repairs	.0569
Inspection	.0924
Outer Globes	.0118
Inner Globes	.0259

The costs given are the averages for about 3,500 enclosed arc lamps in Kansas City.

The estimate of Pittsburg flood losses is now advanced to $50,000,000. And that is but one point where floods are playing havoc in western Pennsylvania. Skinning the country of forests so that water runs off the land as from a tin roof is costly business.

New Zealand has produced $325,000,000 worth of gold in the last fifty years, and yet the surfaces of the gold-bearing deposits have been worked comparatively little. Great possibilities await further prospecting and mining, combined with scientific methods.

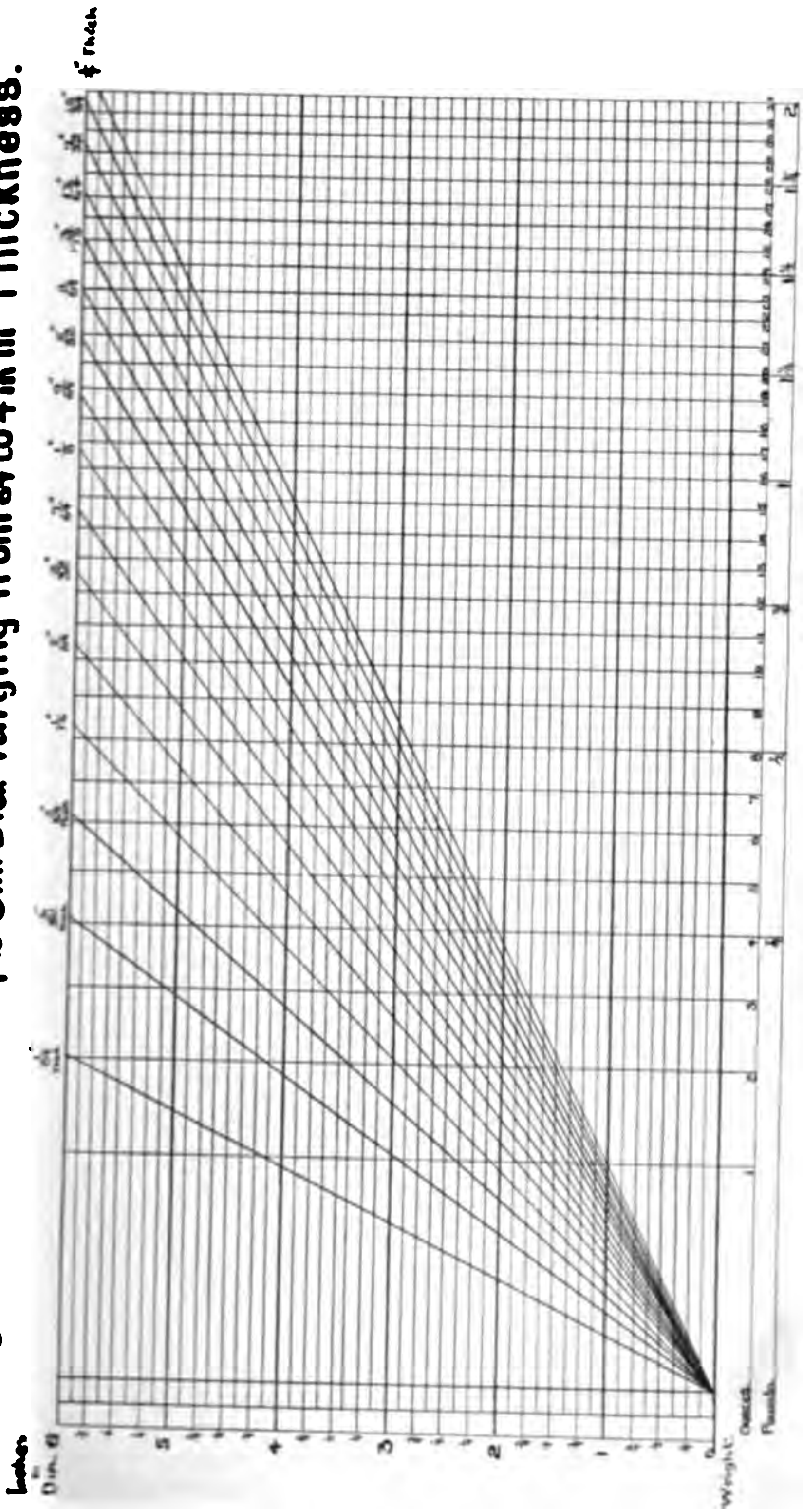
An Estimating Chart for Brass Rings.

BY VOX POPULI.

SOME time ago part of my duty consisted in getting out estimates for brass rings and discs. There was a big demand for them, but as competition was very keen, it was necessary to figure close. It very rarely happened that two orders came in alike, especially for rings where the inside diameter and the outside diameter varied to every combination of dimensions imaginable. It took up considerable amount of my time figuring out the areas and weights, in fact I used to have to work late nearly every night. After putting up with this for about two months I set to work to devise something which would save so much figuring and time, I thought of making a table showing the different weights for all the sizes and all thicknesses, but as the diameters varied anywhere from 1/16 in. to 6 in. by 64ths and as there were over 16 thicknesses, it would need a table showing over 6,000 totals which would be too cumbersome for practical use. Eventually I devised the chart shown in the illustration from which I could directly read the weights of any ring or disc of any dimension and any thickness within 6 in. diameter. For the rings I would get the inside diameter weight, and subtract it from the outside diameter weight, the result giving the weight of the finished rings.

A similar chart can be constructed for any material and will quickly repay its cost, where any estimating has to be done. In making a chart for this kind of work notice that the horizontal lines are drawn to actual inches and eighths, and the vertical lines are spaced according to the square root of the number of ounces or pounds as the case may be. This ruling causes the curves for the different thicknesses to become simple straight lines, and it also shows up the small dimensions on the enlarged portion of the scale.

Weight of Brass Discs up to 6 in. Dia. Varying from 1/32 to 1/4" in In Thickness.



Crane Design.

BY PROF. A. EDWARD RHODES.

PROBLEM:—Figure 1 represents a wrought iron crane. How would a draftsman compute the strains in the different members so as to determine their dimensions? The crane is to support a weight of 1,000 pounds, as shown.

SOLUTION:—Knowing the lengths of the several members draw the center lines through all the members and thus obtain a skeleton plan, as shown in Figure 2.

Now consider the horizontal jib E L to be a beam in equilibrium supported at B and loaded at each end. Next compute the vertical pressure at B due to the loads on the lever E L. This is found by the principle of the lever to be

$$\frac{42 \times 1{,}000}{26} = 1{,}615 \text{ pounds, fraction neglected.}$$

Draw the vertical line B C, say 8½ inches long, and through C draw the horizontal line A C, intersecting B D in the point A, thus obtaining the triangle A B C, whose side B C represents the vertical force acting downwards at B, the side A C, the tension in the horizontal member E B, and the side A B, the compression in the strut B D. If B C is 8½ inches long, then will A C be 13 inches long, and A B 15.6 inches very nearly. The forces which the sides of this triangle represent are proportional to the length of these sides. B C represents 1,615 pounds, hence A C represents

$$\frac{1{,}615 \times 13}{8.5} = 2740 \text{ pounds.}$$

which is the tension in B E. The side A B represents

$$\frac{1615 \times 15.6}{8.5} = 2905 \text{ pounds.}$$

which is the compression in the strut B D. Now find the horizontal force H, which must be applied at the bottom V of the post to hold the crane in equilibrium. The load of 1,000 pounds with a leverage of 42 inches, hence its moment will be $1{,}000 \times 42 = 42{,}000$. Let the upper end T of the post be the origin of moments, or, in other words, the point about which the forces turn; then for equilibrium the moment of H, acting with a leverage of 36 inches, must be equal to the moment of the load, namely, 42,000, hence the horizontal force H will be

$$\frac{42{,}000}{36} = 1{,}166 \text{ pounds.}$$

The draftsman now is in a position to determine the dimensions of the different members of the crane.

The lower part D V of the post may be considered as a beam fixed at D and subjected to a transverse force H of 1,166 pounds at the end V. The strength of this beam is measured by the load it can carry, and this is represented by the formula (1)

$$W = \frac{S \times I}{l \times C},$$

in which W=load in pounds, S=safe stress per square inch in outer fibers of the beam, for which the draftsman may take 12,000 pounds for wrought iron, I=the moment of inertia, l=length of beam in inches, and C= the distance from the neutral surface of the beam to the most remote fibre. For a circular section the moment of inertia is

$$\frac{3.1416\, d^4}{64},$$

and c will be equal to ½ d, in which d = diameter in inches of the section.

Substituting these letters for those in formula (1) you have

$$w = \frac{s \times 3.1416\, d^4}{l \times \frac{1}{2} d \times 64}$$

This reduces to

$$\frac{s \times d^3}{10.18 \times l} \quad (2)$$

from which you deduce

$$\frac{w \times 10.18 \times l}{S} = d^3 \quad (3)$$

Substituting in formula (3) for the letters their values you have

$$\frac{1.166 \times 10.18 \times 16}{12{,}000} = d^3 = 15.8$$

and the cube root of 15.8 is 2.5 nearly, which is the diameter of the lower end of the post required for resisting the transverse force only.

The corresponding area should be sufficiently increased to resist the compressive

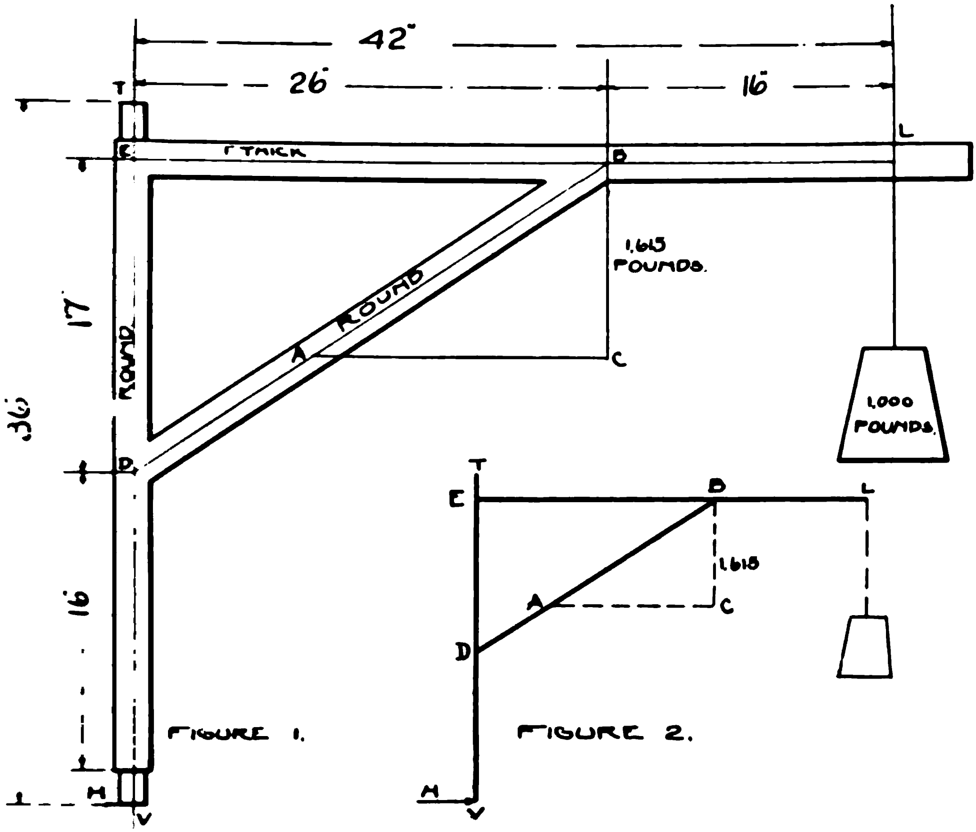


FIGURE 1.

FIGURE 2.

...ams due to the load and the weight of the ..., but this increase will be comparative- ... small, an area corresponding to 2⅝ inches ... will be sufficient for all purposes; ... the diameter of the post should be 2⅝ inches.

The portion B L of the horizontal jib may ... considered as a horizontal beam fixed at B and loaded at the other end L. This jib ... be, according to the sketch 1 inch thick. The formula for finding the depth is deduced ... from formula (1) by giving the proper values for I and c. The moment of inertia of rectangular sections, such as this jib is ... have, is

$$\frac{b\,d^3}{12}$$

... which b = breadth in inches, and d = depth in inches of the beam, and for sections of this kind C = ½ d. Hence formula (1) may be changed to

$$W = \frac{s \times b \times d^3}{l \times 12 \times \frac{1}{2}d}$$

This reduces to

$$W = \frac{s \times b \times d^2}{6 \times l}$$

from which you deduce

$$\frac{w \times 6 \times l}{S \times b} = d^2 \quad (4)$$

Substituting in formula (4) for the letters their value you have

$$\frac{1{,}000 \times 6 \times 16}{12{,}000 \times 1} = d^2 = 8$$

The square root of 8 is 2.8 inches, which is the depth of the beam B L to resist the load only. This depth should be increased so as to allow for the tension of 2,470 pounds in E B of the horizontal jib; this increase of depth will, however, be comparatively small; 3 inches for the depth of jib will be sufficient. The ultimate compression C per square inch which the strut B D can resist is found by the following formula:

$$C = \cfrac{f}{1 + \cfrac{l^2 + r^2}{a}} \quad (5)$$

in which f = a coefficient depending upon the nature of the material, it is usually taken at 40,000 for wrought iron, l = length of strut in inches, r = radius of gyration of the cross-section of the strut, the squaie of this radius is equal to the square of the diameter divided by 16, and for struts which are hinged at both ends, as this one is assumed to be, a = 20,000.

If 1⅛ inches is selected for the diameter of the strut, whose length has been found to be 31.2 inches, then by substituting these values for the letters in formula (5) it may be found that the breaking load in pounds per square inch of area of section

$$C = \cfrac{40{,}000}{\cfrac{973.44 \div 0.72}{20{,}000}} = 37{,}582 \text{ pounds.}$$

The cross-sectional area of a strut 1⅛ inches diameter is practically 1 square inch, the result of the computation shows that the breaking load is nearly ten times greater than the stress in the strut, hence it may be assumed that a strut 1⅛ inches diameter is strong enough and safe.

Wilmington, Del.

Correction on Data Sheets.

The data sheet of May, 1907, containing tables of safe load in thousands of pounds for standard I-beams used as columns with square ends, had an error in the formula

$$P = \cfrac{50000}{1 + \cfrac{(12 \times L^2)^2}{36000 \times r^2}}$$

The (^{2}) in the part of the expression $(12 \times L^2)^2$ should have been omitted. It should read $(12 \times L)^2$, in which L is the length in feet and is reduced to inches by multiplying by 12.

The Draftsman.

A DRAFTSMAN there was, and he made his prayer,
Even as you and I,
To a right line pen, and a wooden T square,
For he knew they earned him a living fair,
So he went to work, and he banished his care,
Even as you and I,

He worked with a will, and he earned his pay,
Even as you and I,
And the big chief saw that his work was good,
So he paid him more, as a good chief should,
And the draftsman worked harder, as I knew he would,
Even as you and I,

Now I hope all the bosses will think about this,
Even as you and I,
And consider their men, and pay them well,
So they won't be watching for the five o'clock bell,
But will hustle their job and work like ——,
Even as you and I,

—By Jim Bind, with apologies to Mr. Kipling.

Razing Buildings.

TEARING down buildings with a minimum waste of marketable material requires much care and judgment. The steel skeletons of modern buildings are most valuable, and are so carefully taken down that the modern house wrecker is able to restrict the loss almost entirely to the rivets. This old material is used in new structures, it frequently being found convenient to design the new structures with a view to using it. Where buildings are erected with the knowledge that they are to be demolished after serving a definite and short lived purpose, such as those used for expositions, the wrecking companies keep a careful record of the material which goes into the building, to be able to bid intelligently upon the contract for tearing them to pieces, and also to know in advance just what material and in what sizes they will have available for sale or use when the buildings are finally razed.

THE INDUSTRIAL MAGAZINE

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The Thebes Railroad Bridge.

By Chas. Alma Byers.

THE new railroad bridge across the Mississippi River at Thebes, Ill., a point one hundred and thirty miles south of St. Louis and twenty-six miles north of Cairo, is an interesting though typical work of modern railroad bridge construction. It was built under the direction of the Southern Illinois & Missouri Bridge Company, and for the purpose of serving as a sort of connecting link between the Illinois Central, the Chicago & Eastern Illinois and the St. Louis Southwestern railroads on the Illinois side of the river, and the 'Frisco System, the Iron Mountain, and the St. Louis Southern railroads on the Missouri side. Its construction was authorized by an act of Congress, January 26, 1901, and on May 25, 1905, it was completed, tested and formally declared open to railroad traffic. Therefore the period covered in its building was about four years, but on account of numerous delays the time really required for the work has been conservatively placed at two years and seven months.

The Thebes bridge, as it is commonly called, is a continuous steel structure of five spans, supporting a double track. The channel span, the longest, is 671 feet in length, which, with the single exception of the Memphis railroad bridge's channel span, is the longest trussed span, not an arch, in this country. The lengths of the spans on each side of the channel span are 521 feet 2 inches, while the two end spans are each 518 feet 6 inches in length. This therefore gives the steel superstructure a combined length of 2,700 feet 4 inches. The

Casing for Pier Building.

trusses, of the pin-connected type, are supported on six piers of ashlar masonry—a stone surface with concrete core-founded on solid rock, five of which have pneumatic caisson footings. These trusses are 32 feet apart, providing horizontal and vertical train clearances, respectively, of 27 feet 8½ inches and 22 feet 6 inches.

The total weight of the steel superstructure is 26.880,000 pounds, or 13,440 tons. Per lineal foot the weight of the free spans is 11,560 pounds; of the suspended spans, 7,720 pounds, and of the cantilever arms, 11,650 pounds.

The bridge is approached at each end by concrete arches—seven on the Missouri side and five on the Illinois side—each of which is 65 feet in length, with the exception of one of the former, which is 100 feet long. Portland cement was used in the arches, and of this material 35,000 cubic yards was required. The roadbed on each approach is double-tracked, ballasted, and laid with 85-pound rails.

The total cost of this bridge was $2,800,000—of which amount $1,400,000 was for the steel superstructure, $600,000 for the piers and foundations, and $300,000 fpr concrete arches. To a few readers this may seem an enormous amount to expend for the building of a single bridge. but when the traffic matter is considered the student of trans-

portation economics will readily realize that wisdom prompted the work. It is an important link between several large railway systems, and as an illustration of this it is interesting to know that during the first four months that the bridge was in use 2,856 freight and passenger trains crossed it. This is equivalent to 714 a month, or 24 a day.

On the day of its dedication to traffic a testing of its strength was made with twenty-eight large-size locomotives of modern type, representing a combined weight of 8,000,000 pounds. The engines passed slowly from one end to the other, and only small deflections were made. The floor system of the bridge is designed for a concentrated load of 50,000 pounds, to be followed by a load of 5,000 pounds per lineal foot of track. Eighty per cent. of this weight is proportioned for by the trusses, while the steel has an elastic limit of 37,000 pounds, giving an ultimate strength throughout of 70,000 pounds.

The Mississippi River at the point spanned is 2,700 feet wide be-

Showing Concrete Approach, beginning of Superstructure, and Piers in the distance.

tween high-water banks and 2,400 feet wide between low-water banks. The steel work is elevated 65 feet above high water, so that boats may pass easily under it. From the highest part of the superstructure to the bottom of the deepest pier it is 231 feet.

Showing one end of Superstructure reaching out over the river.

Looking through the Thebes Bridge, showing double track.

The Thebes Bridge complete

The Wachusett Dam Slip.

By Lindon W. Bates.

A SHORT time ago, on April 11, without a warning symptom, a dam slip, little short of a disaster, occurred at the North Dike of the Wachusetts Reservoir of the Metropolitan Water Works of Boston. At the highest point of the embankment a section some 675 feet long and approximately 100,000 cubic yards in volume subsided and slid from its place into the water, leaving the earth core exposed.

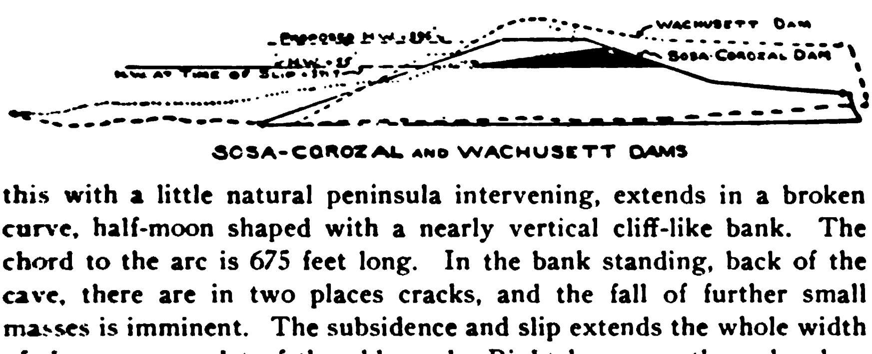
The reservoir dike is of recent construction. It was designed to withstand, at this short section, 65 feet of water. On the date of the collapse it had but 41.7 feet of head, and this was the highest gauge that had ever yet been admitted. The level lacked, therefore, 23.3 feet of the height for which "with unprecedented margin of safety," according to its designer, this embankment was built. In other words, the reservoir was less than two-thirds full, and impounded but half the ultimate contents planned when one-seventh of the crucial volume and section performing the ordinary functions of a dam went down. It subsided and shot out with sufficient momentum to send its rock facing, its gravel, part of the earth ridge and earth core, several hundred feet, in almost a moment. The local journal giving the report says:

"Suddenly there was a rumbling and the noise of huge rocks falling together, and the whole construction of the dike trembled as if shaken by an earthquake.

"When the railroad men appreciated the size of the disaster, and that came quickly, the question of the safety of operating trains over the Central Massachusetts Railroad was raised. A severe vibration it was thought might send down another section of the embankment. The hole that is made in the big bank is a monster, and it is well worth a trip to view what Nature can in a moment do to put at naught the efforts of man." Nature did indeed smite here a few complacencies, when, in the providence of God, before the water reached nearly its destined height, she repudiated thus forcefully the engineering illusions, and took back her own. Had the reservoir been full and thus all the unstable and fateful mass under the crest been saturated, would anything have diverted from lower Clinton and the valley below the fate of Johnstown? Would they not have joined Galveston, St. Pierre,

San Francisco and Kingston in the growing list of great disasters? The gratulations that weaknesses and faulty designing brought a reckoning to but 675 feet out of the two miles of embankment are as quaintly audacious as they are misleading, since a visit to the locality discloses that THIS SECTION IMMEDIATELY AT THE SAG OR OUTLET OF SANDY POND IS THE ONLY PART OF THE EMBANKMENT WHICH HAD AGAINST IT ANY WATER AT ALL. Except at the sag, the reservoir, less than two-thirds full, made no trial whatsoever in any way or degree of this earth dam, and the water, owing to the natural configuration of the ground, had no more chance for an escape than has the swan boat lake in Central Park. At the sag, however, there was a chance for failure, and here two slides did befall under the partial head.

The smaller or south slip occurred where there was but a few feet of water against the face. This trivial amount, even, was enough to melt the slope like sugar and let the gravel facing and berm slide away. The second break, beginning a couple of hundred feet north of



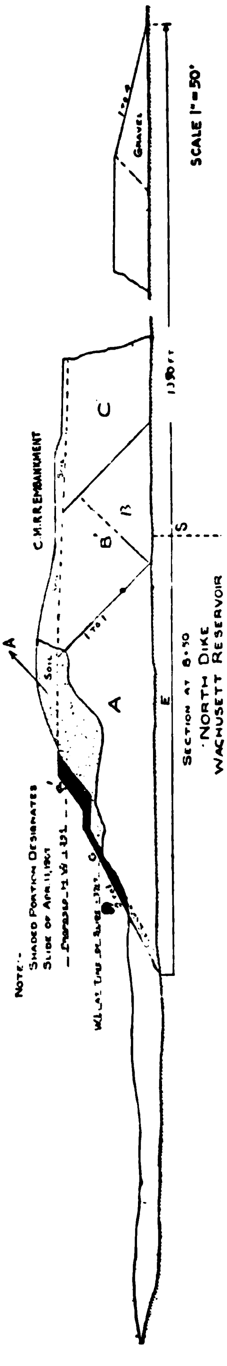
SOSA-COROZAL AND WACHUSETT DAMS

this with a little natural peninsula intervening, extends in a broken curve, half-moon shaped with a nearly vertical cliff-like bank. The chord to the arc is 675 feet long. In the bank standing, back of the cave, there are in two places cracks, and the fall of further small masses is imminent. The subsidence and slip extends the whole width of the sag or outlet of the old pond. Right here was the only place calling for what one would seriously deem a dam. The Lake Reservoir has been lowered about a foot below the critical level since the misfortune. Though being two-thirds full, it shows numerous low islands and knolls. In only two places did the waters even touch the toe of the slope in this work of engineering art, and, except at these two places, the edge of the water is from fifty to several hundred feet distant from it, with stretches of bare, sandy flats, stripped of vegetation, and from two to six feet above water, intervening. The dike is all, except at the sag, a mere rip-rapped levee. It never elsewhere, even when full, would have had against it more than twenty feet or so of water—half the depth that presses in floods against thousands of miles of levees unknown to fame.

Examining the detailed plans, specifications and works of execution at this reservoir, one notes that they reflect two dominant ideas, one an invention, the other a specialist's concept and exemplification of the Hazen formula, of through and underdam percolation, together with unique ideas touching the selection and distribution of materials for earth dams, their slopes and loads.

To the invention per se (a method of setting sheet piling in panels to depths of fifty or sixty feet, where favorable material permits) we record the free and open homage always due to a successful expedient. The sheet-piling is extended, however, not only under the short dip, but under all the rest of the long embankment, which, as was said, will never have more than twenty feet or so of pressure. Equally, across the long plateaus and at the trough of the old pond, a great trench was dug where possible sixty feet deep and the patent sheet piling was driven in the bottom another fifty or sixty feet. If ever the engineers of the Boston water supply should dominate the construction of the levee system on the Mississippi River it would take the National and State treasuries to pay for the thousands of miles of sixty-foot trenches and sheet piling which they would install, for the river dikes have to meet double the head pressing on most of the Wachusett construction.

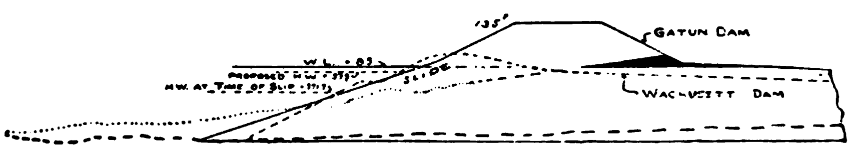
There was a little gap, however, that at the old pond neck or outlet about 675 feet across. The earth dam here was to hold back water to the depth or head of sixty-five feet. This situation was "met" in a special design and construction, with which its creator was so content that he planned its immortality. He had gone with two other similarly eminent specialists to sit as final judge and jury upon



A—Ridge of triangular section in front slope of two horizontal to one vertical, and real slope of one to one. Material taken from E. B. packed or rolled clayey earth six-inch layers supported by A. C—Mass of earth to minimize rate of percolation through and under the dam. E—Ground (natural). G—Gravel layer and term. S—Sheet piling. R—Rip-rap ten feet thick.

The slide in this dike is, however, unfortunately, not an isolated misadventure to be casually reviewed, while broken personal prestige rehabilitates itself by virtue of charity and silence. It is a national concern and should be studied as such, for it is related directly and intimately to the expenditure of half a billion dollars. The Wachusett Dike carried the destinies of the Government's Panama Canal. The great Gatun Dam, the central feature of the Isthmian Waterway, was designed upon much more adverse foundations, by the selfsame engineer, from the selfsame model, as was the North Dike of the Clinton Reservoir, and the engineering trustworthiness and actual structure are together there weighed in the balance and found ominously wanting.

Earth dams are as old as Mother Earth herself. They have been built successfully and rightly in every quarter of the globe so long as man has been man, so the naive conclusion that the "dike type of earth dam is not discredited" will probably go undisputed. But nature has



GATUN AND WACHUSETT DAMS

certainly repudiated violently this individual design of the earth dam and the quality of discernment, judgment and experience which evolved it.

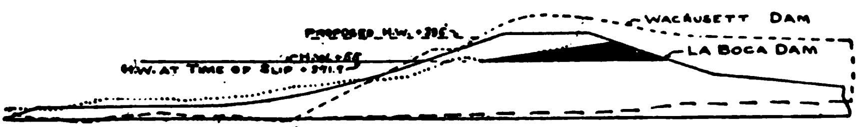
An inspection of Fig. 1 in the illustration shows that the portions A, B, S, C and R are the essential artificial elements. The office of A is the vital one of protecting and supporting the impervious core B, and of carrying the shield of rip-rap against erosion.

Since the earth core B lies on the steep rear slope of A, the upper part of B naturally owes its position and integrity almost entirely to A. It is evident that the stability and integrity of A are a sine qua non of the dam. The material of A is derived from the natural earth, and is the same in character except that (E) is consolidated by rain and aeons of time, while A is a recent artificial ridge. The material is a fine, silt-like sand, water and glacier-ground until its dominant particles have had the angularities rounded. It is, when dry, decently reliable in a bank or cut, but when wet it takes on changed characteristics, just as do the Panama soils. These changes must be anticipated

avowal of creatorship is quoted because with creatorship goes responsibility.

In two instances of gross mistakes in the Panama plans the errors were saddled upon subordinates. Here the authorship of the Wachusett design is formally recorded by the engineer himself.

The Gatun Dam for the Panama Canal was proposed by the five Minority members of the International Board. Of the five, two only were supposedly dam specialists, the designer of the Wachusett Dike and one of the designers of the old Bohio Dam. The latter had been the undoing of the former eighty-five-foot project of 1901. It had been proved impracticable when competent investigation was made and had been completely abandoned. The leadership for the Panama dam problems was accorded therefore to the Wachusett specialist. He projected for Panama on both the Atlantic and Pacific sides a series of high earth dams, the Gatun, "the greatest construction ever undertaken by man." They were brought by their mass and by the special character of their alluvial foundations into the realm of experiment utterly, but they were accepted by the four remaining experts, by the



LA BOCA AND WACHUSETT DAMS

Commissioners and the Secretary of War, all because the North Dike of the Wachusett reservoir was deemed such a convincing and shining example in new and advanced technique.

Its designer explained his art to the Senate Committee: "In some of the testimony it has been stated that this whole matter was an engineering guess. I wish to say distinctly that this is not, in my opinion, an engineering guess. There has been allowed a factor of safety that is beyond all factors allowed in the past."

"Senator Morgan—Beyond all precedent?"

"Mr. Stearns—Beyond all precedent, except in the case of this dam which I built, which is the precedent for this particular construction."

The five experts supporting the Isthmian proposition wrote: "The nearest precedent, in general design, for the Gatun Dam is the North Dike of the Wachusett Reservoir, which at its deepest place will have sixty-five feet against it. The highest portion of this Dike was built on exactly the plan proposed for the Gatun Dam."

factor of saturation from twice the head of water, and five times the annual rainfall on a still more treacherous material. From the first two elements alone two or more million cubic yards would be the relative equivalence. Two or more million cubic yards from the Gatun Dam of silt-jelly from Limon Bay or mud of the swamps, or the sliding clays or pasty ashes of Culebra, going down with a crash into Gatun Lake, and leaving the over-topped mass of the earth-fill at the scour of its waters, would mean a mortal disaster for the waterway. It will be presently seen that the foundation safeguards which were incorporated in the Wachusett Dike were not, according to the latest official testimony, to be embodied in the Isthmian Dam, so that its hazards from this further source are enormously increased. The repair of the very high dams at Panama will be particularly difficult. The Culebra Cut will be finished. Its material will have been transported and deposited into embankments, and before more could be supplied, steam shovels and their train system must be installed de novo. The lake depth, 85 feet, is too great to admit of repair, by the quick and effective methods of hydraulic dredges. Yet every minute and second after an accident would be momentous, and the Gatun Dam, if the slope rearward was overtopped, would soon be in the Atlantic Ocean.

The vital and inescapable dangers prepared for the country in this "Monster Gatun design" were clearly set forth and impressed with all the force that the English language allowed by the Majority of the Consulting Engineers, but the public has been mostly unacquainted with their message. This formidable slide of the Wachusett earth dam comes to confirm their prophecies.

With the Metropolitan Dike, and the accident which sent one-seventh of its critical volume to the bottom of the Reservoir, we concern ourselves only as it is the pattern, the model and precursor of its great progeny, the Isthmian Dams.

Before the Investigating Committee of the Senate, the designer of all these structures, detailed the series of laboratory tests with earths from which he demonstrated the different permeabilities, resistances capillary actions, etc., in materials. Part were made at Lawrence, part at Clinton, Mass. They were conducted with a "galvanized iron tank filled with the sand or other material to be tested, the water being applied at the top and being drawn out at the bottom through a faucet. By opening or closing the faucet, different quantities of water could be made to pass and the difference in amounts of resistance caused by

waiting for time to sift and test duplicated them in each and every embankment projected to hold up the big deep lakes on the Isthmus. The integrity of the Gatun Dam, with over 30 million tons of earth, holding up Lake Gatun at eighty-five feet and of the Corozal and La Boca dams with 18 million tons to create and sustain Lake Sosa at sixty-five feet above low tide, has been assured to the Nation upon the authority of the designer and design of the archetypal Clinton structure of great claims and sorry discomfiture.

The design was repeated in colossal forms, once at Gatun and thrice near Panama. Each, and every one is the Wachusett Dike in a magnificat.

Almost immediately after the assembling of the "Board of Consulting Engineers," before there had been any time or opportunity to digest the isthmian data or examine the physical factors and conditions, the author of this construction, a member of the board, began the paean and the propaganda to duplicate the Wachusett performance on a grand scale, and make it the central and glorified feature of the Panama Canal. The collective body, at his invitation, went down to Boston to study this last achievement in engineering. When, however, the Isthmian structure and its allied feature, the lock flights, were proposed they arrayed the two parties of the board in opposition which divided them fundamentally. The dam, to weigh over 30,000,000 tons, was to be the hugest structure ever attempted in history. It was therefore in that fact alone an experiment with no precedent of guarantee in time or place. The Majority therefore set themselves squarely upon the first tenet—the Panama Canal should not be an experiment in canal building. "The Board is unqualifiedly of the opinion that no such vast and doubtful experiment should be indulged in, but, on the contrary that every work of whatever nature should be so designed and built as to include only those features which experience has demonstrated to be positively safe and efficient."

Having thus condemned the principle of adventure and speculation in the great national work, they proceeded to point out the chances against the success of this particular experiment. The foundations at Panama were not of rock but of acknowledged alluvium. In the Gatun Gorges there was a surface stratum of clay, in places but 31 feet thick. Underneath this, extending from 31 down to 204 and 268 feet, the material was pervious, water-soaked and artesian, the discharge rising in the driven tubes from 7 to 18 feet above the

prevent seepage or percolation, wherever it was apprehended that the nature of the substrata was such as to permit it. It is the judgment of the Board that such safeguarding features as core walls, sheet piling or the removal of unsuitable material should not be omitted in similar structures on this work of extraordinary magnitude and supreme importance."

The Minority five then conceded this. They wrote: "In the construction of the Dam it is proposed to excavate surface material to such an extent that the impervious material of the embankment will come in direct contact with the impervious clayey material. Also to do any other work required to cut off the flow through any pervious material which futher investigations may disclose." They added for this allowance to be included in the estimate of cost of the dams of $400,000. The Gatun dam became, therefore, safeguarded in the exact way as had been the Wachusett dike, so it was supposedly vouched for and guaranteed in the success of its small predecessor.

Soon, however, the five engineers were brought up to the practical question of "How? How?" Then the Panama proposition went off into the air and the Gatun Dam fell summarily out of even the Wachusett class. The pervious strata in the two gorges at Gatun extend to 204 and 268 feet, much below the limits of caisson or sheet piling work. Their width at sea level is roundly 2,700 feet. It became speedily patent that these experts had proposed and stipulated the physically impossible, since cutting off the water in the deep gorges was the dream of Engineer Quixotes. Before the Senate Committee, therefore, they openly and entirely abandoned the provision thus categorically specified. The Isthmian structure of 30,000,000 tons in weight under an 85-foot head was there acknowledged to be then projected and advocated without the defenses and precautions which had been incorporated to safeguard the small Wachusett Dike, with but 65 feet of head, against some 675 feet alone of its length. Notwithstanding this, they argued speciously and persistently that the Gatun Dam would be quite safe. Why not? They had tested sands and gravel carefully in two laboratories, in tanks and tubes with three feet of material, a faucet and a miniature dike in a box. They had settled the slope, the permeability and all other factors of safety, as the designer averred, "beyond all precedent, except in case of this dam which I built."

The lock flights complementary to the pernicious high dams were pronounced by the Majority of the Board of Consulting Engineers even more dangerous and objectionable than the dams. It was re-

corded that they were "perilously near impracticable for battleships" and extra hazardous for large merchant ships. But the Triumvirs have just reported that the rock (argillaceous sandstone is its latest name) will withstand the concrete lock weights. It has all been tested and proven in another box of sand. They write, "additional tests were made at our request with an improvised apparatus to give a further indication of the ultimate supporting power of the rock. In making these tests irregular pieces of the rock about three inches to ten inches across were bedded in sand in a box resting on scales, so that the top of the pieces would be substantially level; the top was then made smooth and pressure was applied on an area one inch in diameter."

All this teetering of weights as settling the question of lock foundations is quite beside the mark. No one has disputed that the "sandstone," where it exists, is a good and adequate foundation for a lock. But what of the foundations where it does not exist, and the masonry must repose upon the pervious strata? These are the conditions which are impeached. There is no mention of this feature in the "deciding report." The objections to the lock tiers are not answered or touched by testing the crushing limit of indurated clay. The relation of the lock tiers to navigation, the locating of the lower lock and approaches in a morass, the setting the upper lock to overhang this "argillaceous sandstone," the absence of foundations for the upper approaches, the impracticability of establishing proper safety dams to safeguard the lakes, the inadequate width of the locks to anticipate batleship growth, questions of future lake saturation in the pervious strata under the locks, all these and many allied problems are avoided. This is circumspect. Bohio and Wachusett consort illy with Delphic oracles. Pronouncements are promised upon the Gatun Dam. The country knows just what these will be. Judging the future by the past, the corroboration of former decisions will be complete and unanimous, and it will be announced anew to the world that the Panama dams are safe and certain—like the North Dike of the Wachusett Reservoir.

American and German Electrically Operated Lift Bridges.

By Frank C. Perkins.

A NUMBER of electrically operated rolling lift bridges have been installed during the past few years in American cities, as well as abroad, notably at Chicago, Cleveland and Buffalo, and electric power is found to be most satisfactory for this purpose, as the motors occupy but little space and are very economical in operation, no energy being wasted when the bridges are not being moved. With steam hoisting gear a fire must be kept up continually under the boilers, and there is a constant loss through condensation in the steam pipes and boiler, which are exposed and always under pressure, whether the engine is being used or not. The electric control is also very satisfactory, as all of the movements are made with precision and certainty.

The accompanying illustration, Fig. 1, shows a unique German electrically operated lift bridge, recently constructed at the Schwanentor at Duisburg, showing the bridge closed, while Fig. 2 indicates the position of the two movable central parts when the bridge is open, the electrical motors and driving mechanism being noted in Figs. 3 and 4.

The electrical equipment was installed by the Siemens-Schuckert Werke of Berlin, and includes four 12-horsepower direct current motors of the enclosed type, with series winding, operated on a 440-volt direct current power and lighting circuit arranged on the three-wire system for distribution of electrical energy in the city of Duisberg.

The controlling mechanism includes resistance starting boxes directly connected to the horizontal lateral levers for operating the motors forward or reverse, for opening or closing the bridge, two magnetic brakes being connected in parallel and arranged to be operated automatically. The illustration, Fig. 3, shows the position of the operator and the controlling levers and resistances, as well as the gearing for speed reduction, the motors being designed for a normal speed of 850 turns and to decrease in speed by the resistance

to 450 revolutions per minute, the power developed being about 12-horsepower for each motor.

The bridge may be opened or closed in about one-third of a minute, two separate hoisting gears being used, each being provided with two motors, as indicated in Fig. 4, the measuring instruments, cutouts and switches being mounted on two marble panels arranged on the wall, as noted in the background. The switches controlling the motors may be coupled together or operated separately as desired, thus controlling two motors or one by a single movement of the lever if necessary. Two sections of the bridge may be operated by a single motor, running at a speed of about 850 revolutions per minute and developing only about 3-horsepower when there is no wind, or it is very light. With heavy winds each section may be operated by two motors or the two sections may be operated by two motors in order to open and close the bridge in the same time under the increased load. As the load on the motor increases with increased wind pressure, greater power is developed by the motor, as its speed is lowered, on account of the series winding of the machines. The accompanying illustrations of the driving mechanism show how the

Fig. 1—Duisberg Electrically Operated Lift Bridge closed.

Fig. 5—[illegible] Lift Bridge, open.

Fig. 6. [illegible]

of another similar electrically driven 121-foot lift bridge of the Schurzer type across the Chicago River at North Halstead Street. The latter illustration, as well as that of the German electric lift bridge, show the arrangement of the overhead trolley wires for the electric railway service, and the method of supporting the same at the center of the bridge.

Fig 5—Electric Rolling Lift Bridge of Chicago West Side Metropolitan Elevated Electric Railway.

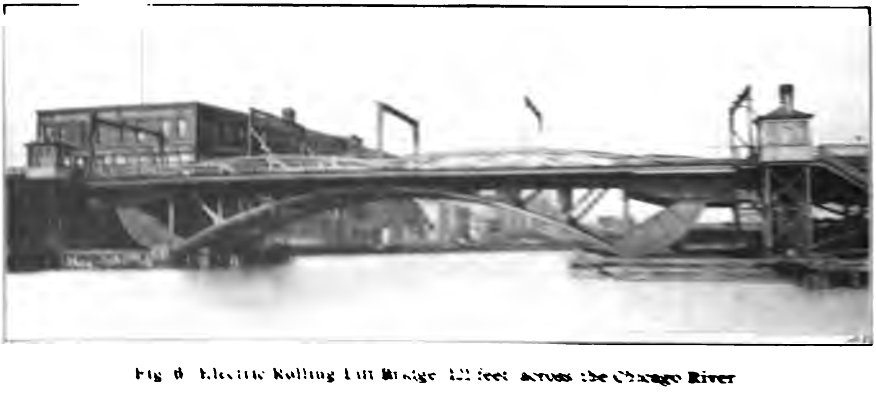


Fig 6 Electric Rolling Lift Bridge 121 feet across the Chicago River

The most important bridge construction in America during the past year undoubtedly has been that of the new cantilever bridge at Quebec, crossing the St. Lawrence River and connecting the United States and Canada at this point. It is maintained that this bridge, now under construction, has the longest span of any bridge in the

Fig 7—North Halstead Street Crossing, Chicago River, on rolling lift bridge.

Semi-ornamental German Bridge at Furth Redrits

Railway Bridge at [illegible] over the River Main.

world regardless of the type, suspension, cantilever or any other design.

The center span of this bridge is 1,800 feet in length and the two side spans 500 feet long, together with the two end sections of 220 feet, making a total length of over 3,200 feet. The total weight of this bridge will be about 80 million pounds, or over 40,000 tons. It is being constructed by the Phoenix Bridge Company of Phoenixville, Pa.

While no very large bridges of this type with very long spans have been built in Germany during the past decade, it may be of interest to note some of the recent constructions by eminent German engineers. At Regensburg, a bridge of a single span of 114.3 meters was constructed over the Donau River in 1900 by the Vereinigte Maschinenfabrik Augsburg and Maschinenbaugesellschaft Nürnberg A. G. of Nürnberg, Germany, and a bridge of similar design was constructed in the same year across the River Weser near Neinburg, with a total span of 118 meters.

Another bridge of two spans with a number of arches was built

German Street Bridge across the River Weser near Neinburg.

Many of the city street bridges in Germany are of ornamental design, decorative features being brought out in the iron work to a greater extent than in America, as noted by a typical street bridge with driveway and foot paths at Fürth. This Rednitz semi-ornamental German bridge was built in 1903, and is 36.8 meters in length.

The country road bridges in Germany are very plain but substantial, although apparently of light construction, as noted in the accompanying illustration of a German bridge at the village or town of Lengfurt, having a total length of about 150 meters. This bridge was built in 1904 by the Maschinenbaugesellschaft Nürnberg and crosses the River Main. The central span is 96.2 meters in length, while the two side spans each measure 32.98 meters long.

Construction Work on a Steel Plant.*

By Chas. M. Ripley.

THE contractor's plant at the above job is of interest mainly for the reason that (1) Excavation work for the blast furnace foundations was done by steam shovels and (2) the gigantic amount of concrete to be laid was over a distributed area, some places one mile distant from mixing plant; and (3) the natural topography of the ground was taken advantage of in laying out the concrete mixing plant.

Excavation Work.

The size of the plant ultimately, the writer is informed, will be 10 blast furnaces with all accessories. The amount of excavation for each blast furnace is approximately 15,000 cubic yards, making a total of 150,000 cubic yards for the furnaces, and not taking into consideration the boiler house foundation, blower house, bloom mills, etc., etc.

It will be of interest to contractors to note the results and low cost of steam shovel work for such excavation work. The cut (Fig. 1) shows roughly the layout of excavation for a pair of blast furnaces, and the broad gage railroad track where a Marion steam shovel with 2½ yd. dipper and a Bay City shovel with 1 yd. dipper, passed through, digging in front and on either side. The large shovel was handled by 3 men, each at approximately $4.00 per day, assisted by 4 track-layers at $1.50 per day each. The smaller shovel was manned by 2 men at 4.00 per day each. There were also 4 more track layers working in connection with this shovel.

The cars for excavated material were of the ordinary broad gage flat railroad cars, owned by the parties doing the work, and holding approximately 16 yds. each. 15 of these are being used in the work, and a shovel gang of 8 men is provided for the unloading of each car. The average length of haul of dirt, is 1,000 feet to a fill that is being made, and of the total 5 locomotives used by the substructure contractors, 3 are used to haul these flat cars. The other two H. K. Porter locomotives are used to deliver materials to the mixing plant, and to haul flat cars with Excelsior bottom dumping buckets containing concrete, from mixer to the place for depositing.

The first two furnace excavations were completed by the above

* Preliminary work on new Jones & Laughlin Steel Plant, Alliquippa Park, Pa.

Mixer Plant as outlined in Sketch Fig. 2.

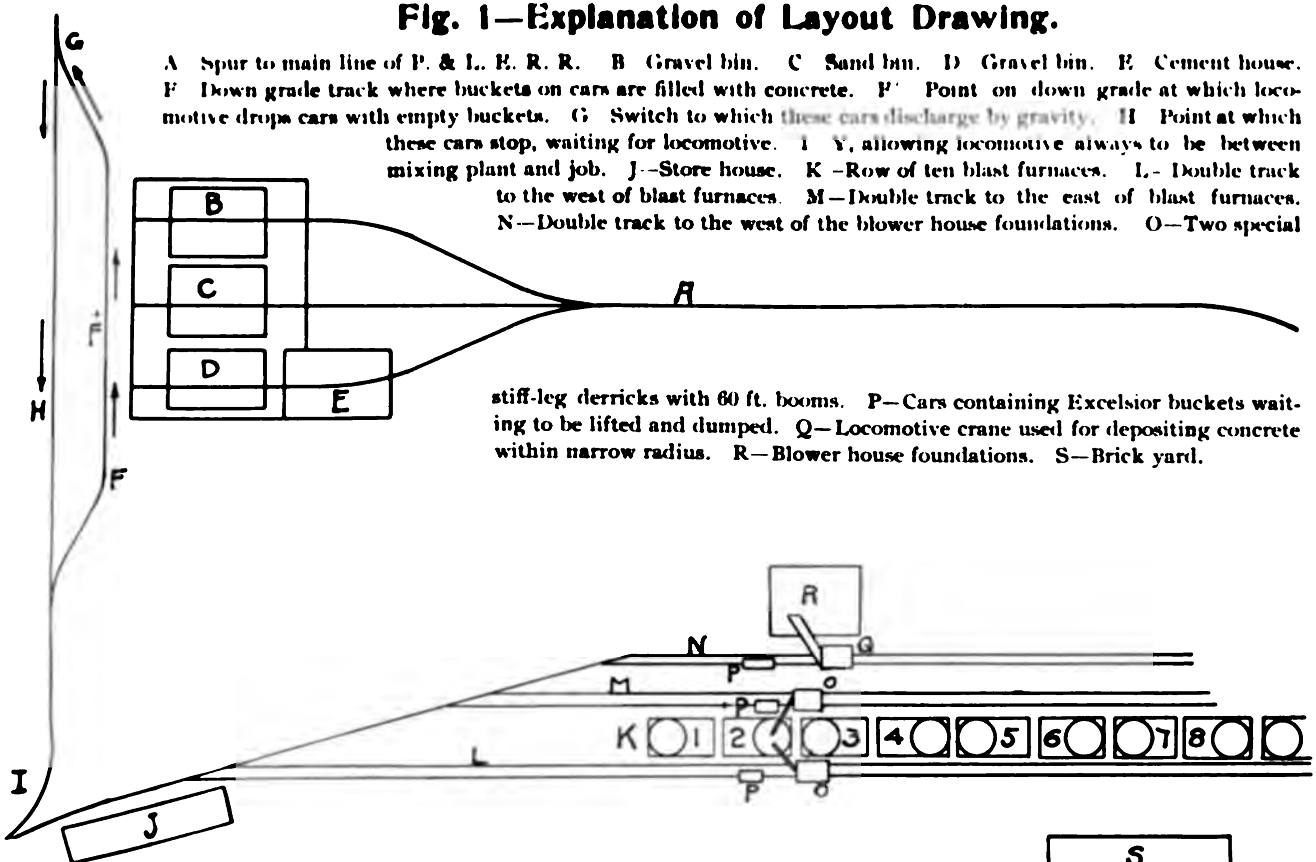
method in 6 weeks, or about 5,000 cubic yards per week. Each excavation pit was 300 x 75 feet and was carried to a depth of —18 with reference to ground level. One of the great elements in reducing cost of this work, was the fact that no water or water bearing strata were encountered and hence no pumps were required and no time wasted from this score. Neither were any piles needed for foundations, as a very hard firm gravel sufficed for this, and further did away with the necessity of sheet piling entirely.

(2) The Mixing Plant.

As seen from the sketch (Fig. 2) the 40 ft. hillside was taken advantage of in saving all hoisting expense. The expense of a skip hoist with engineer, or gang of shovellers, was done away with and all trucking also dispensed with, inasmuch, as the top tracks brought materials direct from the siding, and the bottom railroad tracks took concrete direct to the job, as shown in Fig. 5. The gang consisted of 1 foreman and engineer, the same man acting in the double capacity at about $3.00 per day, and 15 laborers at $1.50 per day. These men with two Smith No. 5 mixers driven by the standard engine (about 19 H. P.) turn out approximately 400 cubic yards per day of concrete, proportioned 1 to 3 to 5. Of late the concreting has been going on night

Fig. 1—Explanation of Layout Drawing.

A Spur to main line of P. & L. E. R. R. B Gravel bin. C Sand bin. D Gravel bin. E Cement house. F Down grade track where buckets on cars are filled with concrete. F' Point on down grade at which locomotive drops cars with empty buckets. G Switch to which these cars discharge by gravity. H Point at which these cars stop, waiting for locomotive. I Y, allowing locomotive always to be between mixing plant and job. J—Store house. K—Row of ten blast furnaces. L—Double track to the west of blast furnaces. M—Double track to the east of blast furnaces. N—Double track to the west of the blower house foundations. O—Two special stiff-leg derricks with 60 ft. booms. P—Cars containing Excelsior buckets waiting to be lifted and dumped. Q—Locomotive crane used for depositing concrete within narrow radius. R—Blower house foundations. S—Brick yard.



and day, and 800 cubic yards for the 24 hours is not an unusual record.

Dragon Portland Cement, of the quick setting class is used on this job, and is delivered in cars as shown in Fig. 2. The steam to supply mixing engines and also water pump a few hundred yards away at the water front, is less than 100 H. P. and is tended by one fireman. Since gravity is used in all handling of materials, the requirements for steam are very limited. There are three tracks upon the top of the trestle work in Fig. 2.

The trestle work was made of 12 x 12 timbers and was approximately 40 ft. in height. It needs explanation that the trestle work contains 3 bins, each bin lying under a track, the outer two being for gravel. One discharges into the measuring hopper of each mixer; the inner or middle bin, situated between the gravel bins and of the same size as one of the gravel bins, is divided into parts, by a partition extending vertically, each part feeding sand to one of the mixers.

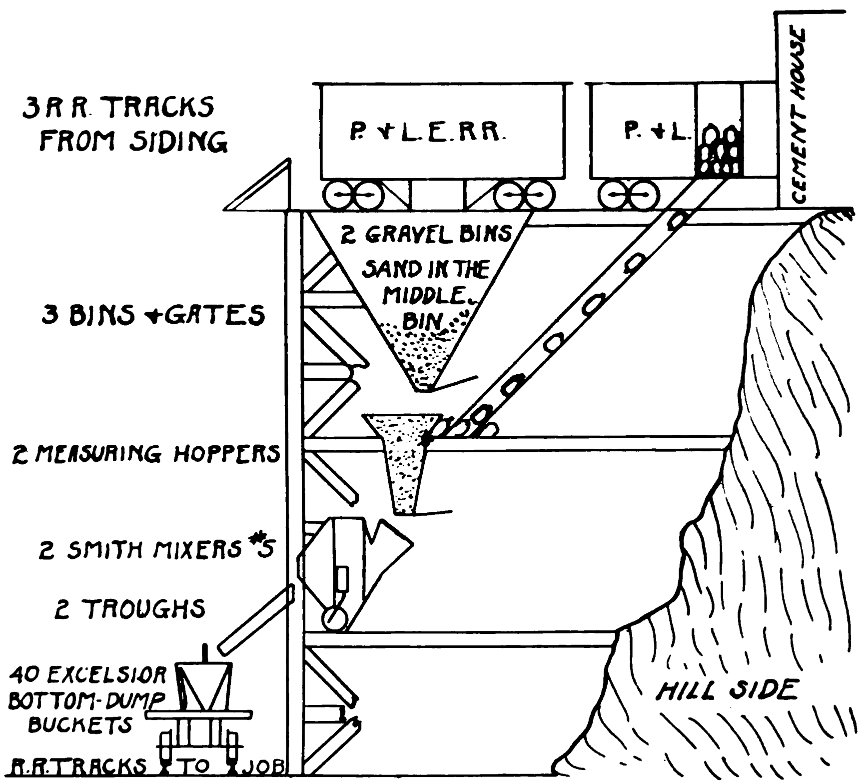


Fig. 2—Cross Outline of Mixer Platform.

Style of buckets for handling concrete. These were placed on ordinary flat cars moved by locomotives.

Buckets handled by special derrick to foundations

One man handling a bucket of concrete.

Thus three bins feed two kinds of materials to two mixers. The cement bags are sent down two wooden chutes at either side of the middle track. The two outer tracks deliver gravel to the bins below them, and the inner or middle tracks deliver sand to the bin below it. The middle track also is used for delivering cement to the chutes as mentioned above.

(3) Delivering Concrete.

An admirable feature of this mixing plant is that one locomotive is more than able to deliver concrete to the several different locations where it is being laid, and which are widely scattered. This is made possible owing to a very ingenious expedient, which can be understood in connection with Fig. 3. The switching and shifting of cars in and about the neighborhood of the mixer, is done entirely by gravity, thus leaving the locomotive nothing to do but drop its load of empties at one location and pick up the loaded cars at another location. By noting the direction of the arrows which denote down-grade, it will be seen that by chocking the wheels, cars can be sent from point where dropped by engine, to point of loading where wheels are again chocked while buckets are being filled. Then, releasing the wheels will cause car to run down incline to the point "B" where the grade is reversed and an automatic switch allows cars to descend in the

opposite direction to the point where they are again taken up by the locomotive.

Trains of two cars are used, each car having 5 Excelsior bottom dumping buckets, made by the G. L. Stuebner Iron Works, Long Island City, N. Y. The superintendent said that only one man was needed to operate buckets, it being easy to both open and close them owing to the construction.

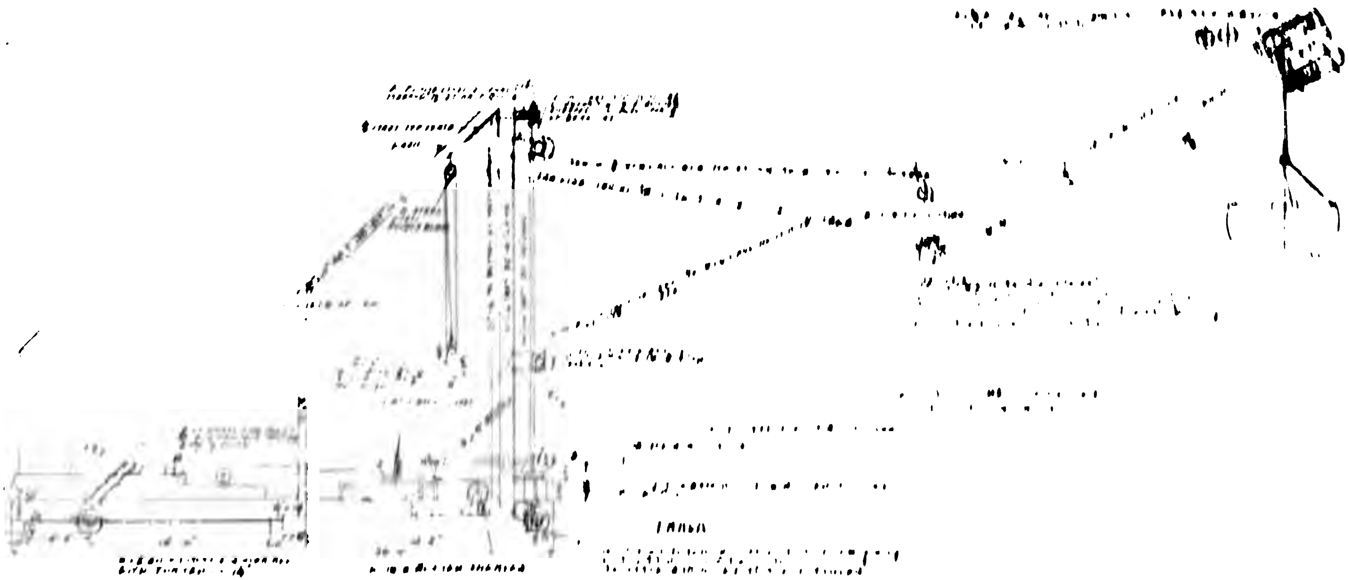
By referring to Fig. 1 again, it will be seen at a glance how the buckets were transferred to the job from the car. Since the work lay a considerable distance from the car, two special hoisting engines and derricks were gotten up by the Carlin Machinery & Supply Co., which were of the stiff leg variety. These embodied several new features.

The most important of these features are as follows:

Owing to the limited space, the gage of these derrick cars was made 10½ ft. and the complete equipment 36 ft. long. The A-frame or front support for the derrick mast is, however, 28 feet wide with Duff Screw Jacks for support from ground after car is moved to position.

A novel and substantial method of securing the top of mast sufficiently ahead or in front of the A-frame is shown in the drawing, so

One man easily dumping a bucket of concrete



Outline of special derricks with 90 ft. booms

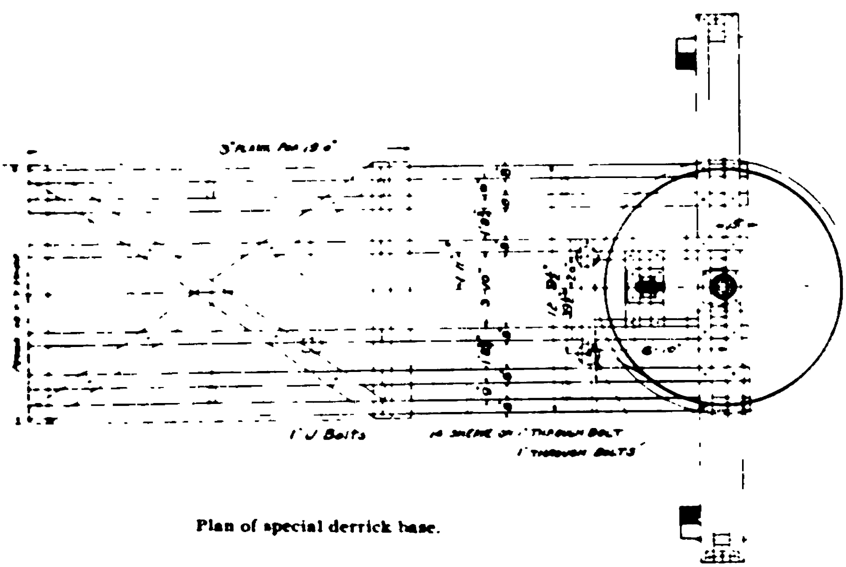
that the 60 ft. boom of the derrick would travel through an arc of about 190 degrees.

The machinery is designed for operating a 1-yd. Hayward Clam Shell bucket, using an 8½ x 10 in. Lambert special hoisting engine with three friction drums and special boom swinging attachment wherein two small drums were used, permitting all lines to clear each other freely by the original method of placing the sheaves at bottom of mast.

The derrick base proper is made in three parts: Base plate having large surfaces for securing to timbers, the derrick base proper, which forms a seat for mast, and the removable knee or boom seat. This base has ample clearance for three ropes, its bearings being 11 in. in diameter. The knee can be readily replaced without materially disturbing other parts of machine.

The improved mast top, in addition to forming a support for the gudgeon pin, which is in front of the mast, allowing mast timber proper to be perfectly vertical so that it can readily be plumbed and the top and bottom bearings in perfect alignment, also cares for three sheaves for properly lacing the boom raising rope. And the sheave pin, in addition to its bearing in the casting, is further supported by heavy steel stirrups passing through top of mast with washer plates at back.

The turntable or bull wheel in this case consisted of a simple

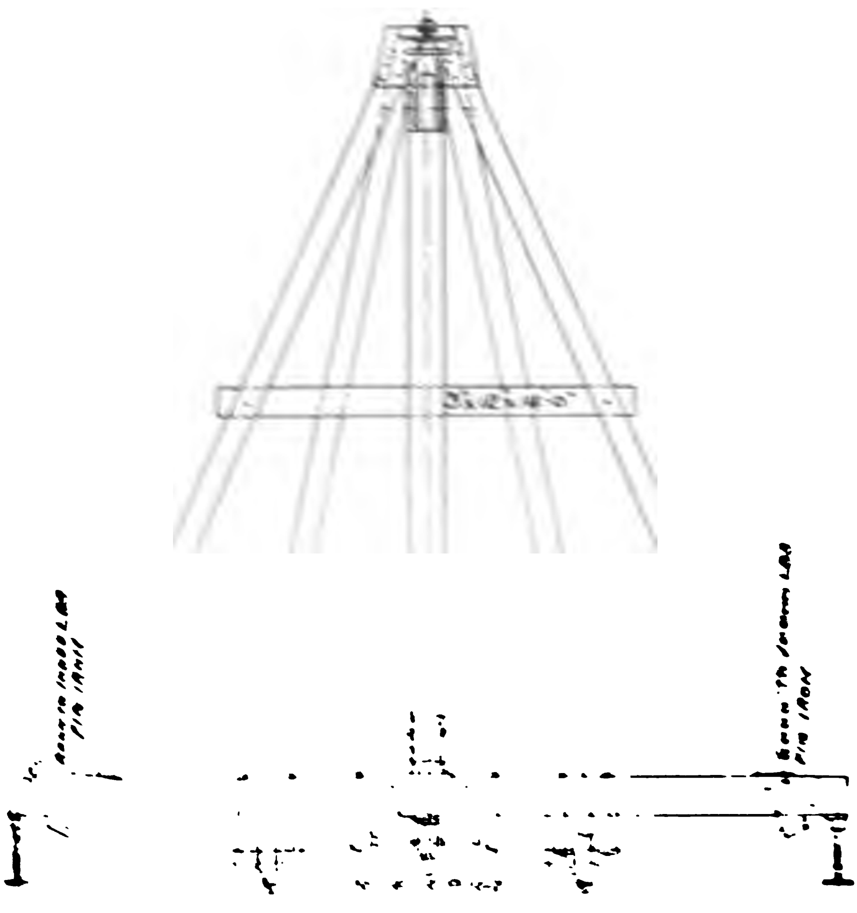


Plan of special derrick base.

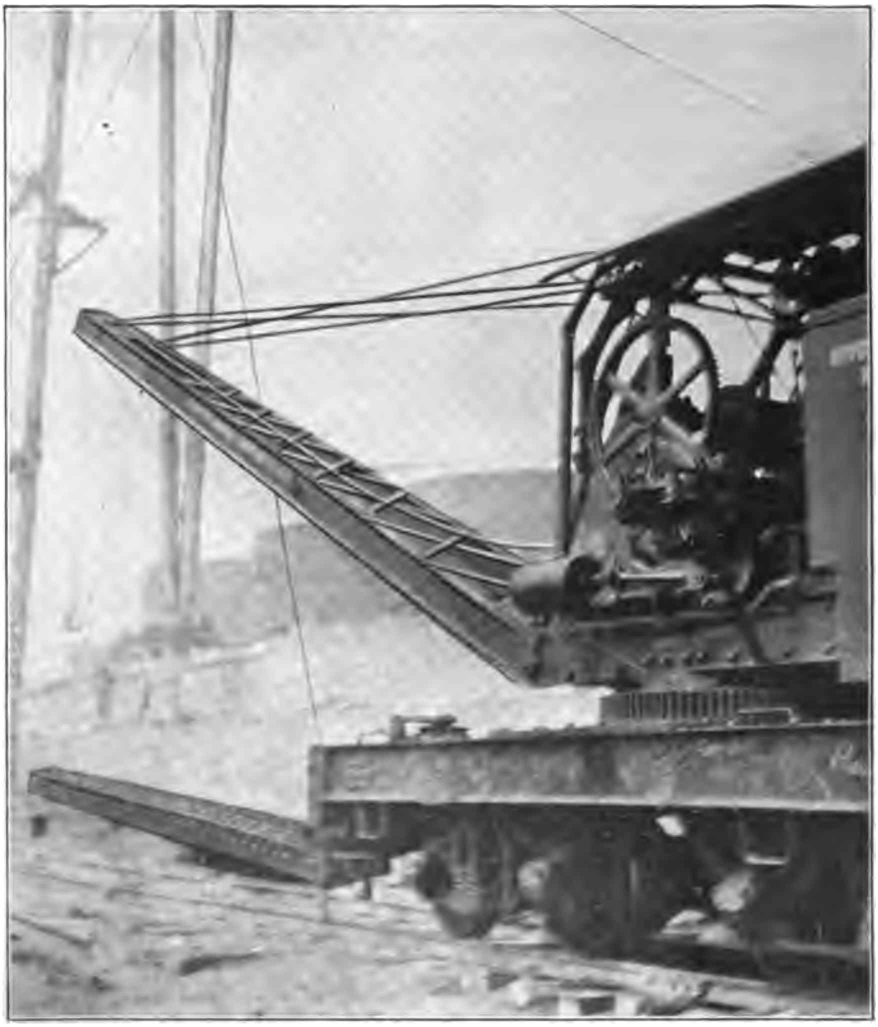
angle iron rim filled in with wood braces.

The long boom is partially supported by the boom bail secured by the end of the boom line, which has two supporting sheaves built into it for carrying the hoisting and closing lines.

A simple and novel set of irons is made for the boom top lift, consisting of a long steel plate covering the two sides of boom and passing around the end with a built up double block for lacing the ropes, and is so designed as to give ample support for all pins, and permits of all sheaves which are mortised in center of boom side by side being readily renewed.



which so many contractors insist upon purchasing. On this job there is a No. 2 Emerson pump with a 5 inch suction and a 4 inch discharge, which is called upon apparently to perform no more work than could be handled by one of our Junior pumps. We always try and sell the smallest pump which will answer the purpose, but there are many times when an engineer will insist on the purchase of a larger size. While the Emerson pumps will keep in continuous operation as long



Locomotive crane handling material at short radius.

cut off from what otherwise would be a fill 2 or 3 miles long, 1,500 to 1,800 feet wide and about 40 feet deep. No contractor's cars of special design are being used, but instead shovellers are employed to handle dirt, as stated above, 8 to each unloading car.

The apparatus used may be rapidly summarized as follows:

Buckets—40 Excelsior bottom dump buckets, G. L. Stuebner Iron Works, Long Island City, N. Y.
Derricks—2 special design by Carlin Mach. & Sup. Co., Allegheny, Pa.
Hoisting Engines—2 Lambert 4-drum.
Locomotives—3 H. K. Potter and 2 American Loco. Co.
Flat Cars—15.
Track—All broad gage. No contractors' cars or industrial railroad.
Locomotive Cranes—2 Bay City; 1 for laying concrete, 1 for roustabout.
Mixers—3 Smith No. 5.
Pumps—Emerson with 3 inch discharge (this was for use in the concrete arch over Log's Run).
Cement—Lawrence Cement Co.'s Dragon Portland.
Steam Shovels—1 Marion and 1 Bay City.

The blast furnace contractors are: Riter-Conley Mfg. Co., of Pittsburg and New York. The substructure is being put in by Jones & Laughlin Steel Co., at Alliquippa Park, Pa.

Mixer Plant at Hogstown Run Arch.

Industrial Sacrifice.

Two thousand six hundred and sixty deaths were reported to the coroner of Allegheny county in the year 1906, 919 of which were the result of accidents in mills, mines or on railroads, the industrials most essential to the progress of Pittsburg.

Many reasons are assigned in the reports of investigations of individual cases. Some of the victims were burned by molten metal, a blast furnace burst, or a huge ladle was upset in the steel mills; others were caught in the rollers in a plate mill and some crushed in the machinery of the mills. Many were killed in mines by falling slate, some by gas explosions, and others by falls from derricks, scaffolds and like structures.

Steel Cars Perilous, Too.

"Steel passenger coaches will not make travel any safer," said D. C. Moon, assistant general manager of the Lake Shore railroad, to a representative of the Cleveland Plain Dealer.

"I am not decrying steel passenger construction," said Mr. Moon. "I see where it might be economy for the railroads to replace present equipment gradually with the new kind, but I can't see where anything is given the public by such an innovation.

"It is certainly not true that the new coach would be built of solid steel. If they were it would take a few more engines to haul them. The present passenger coach, with steel underframes, weigh from forty to fifty tons. All steel construction would mean that the coaches would weigh four times as much. We will have to keep an interior of a certain amount of wood and other inflammables and for that reason the steel car is apt to catch fire.

"In the event of an accident, it would be impossible to reach victims encased in a steel car.

"It is the underframe that ought to be of strong steel. The danger now is in the telescoping of cars. The underwork in the most modern equipments protects against the telescoping as long as the cars stay on the rail. When they leave the rail the steel car would not save the people. The weight, if of all steel make, would do injury. If merely covered by steel on the outside, the situation would be about as it is now."

Accidents Increase.

Notwithstanding the fact that structural iron workers have become more skillful and more precautions are being taken to guard against accidents, the death roll of the skyscrapers is becoming greater every year. Statistics show that the number of deaths and accidents within the past five years has increased more than 20 per cent. in proportion to the increase in building operations.

This increase in fatalities can be explained in two ways. Either the structural iron workers are becoming more careless, or intoxicating liquors so affect them that they are unable to display at critical moments the nerve and self-control that is called for. The engineers in charge of the work blame the accidents on the use of alcoholic beverages. The men themselves seek no logical explanation, but simply answer, "Accidents will happen." It seems worthy of note that many of the mishaps occur on Monday mornings or mornings after holidays.

The causes of the accidents are varied; many of them unavoidable. Workers occasionally lose their balance or are crushed under heavy beams. When in crossing a long span of iron, the worker with his eyes straight ahead on his goal speeds across the narrow girder, a distraction or a jar of the iron may cause a misstep and plunge him to death. Falling rivets now and then kill or injure men who are unfortunate enough to be in their way.

It seems surprising that any arguments which place the responsibility on the effects of intoxication should have any foundation whatever, inasmuch as the class of men who are employed as structural iron workers is far higher now than a score or even a dozen years ago. The men are more familiar with their work, more skillful and more all around mechanics. The modern structural iron worker can do any kind of work on a steel building. He is a riveter, a heater, an erector, and an all around mechanic. With such men the accidents should decrease, instead of increase.

Edward Bruce Moore.

Edward B. Moore, who was not long ago appointed Commissioner of Patents by President Roosevelt upon the recommendation of James Rudolph Garfield, Secretary of the Interior, has the distinction of being the first Commissioner to be appointed from the official force of the Patent Office.

Barr director general, and have adopted a resolution in which, while the governors are retained in an advisory capacity, entire and complete powers are given Mr. Barr, who will reorganize the company by making such departments as he sees fit, appointing the heads and naming the salaries. The Exposition now has what it possibly needed more than anything else—an active head of recognized ability—and while Mr. Barr is serving without compensation he will nevertheless devote his time and energy to the enterprise and will make the Exposition a success.

It is time, we say, for the "knocker" to take a vacation, as his work is about completed. Unfortunately, his work was done only too well, and it will doubtless take some little time to undo his handiwork and eliminate the effect of his nefarious labors. However, as the Exposition is now in good shape, Mr. Barr and the other officials of the Exposition will no doubt take proper measures to correct the existing unfavorable impression on the part of the public, in which the press can be of great assistance, and the Jamestown Exposition will prove to be one of the best and most successful of our great expositions.

Workers vs. Uncle Sam.

It is reassuring to learn from the formal report just rendered to President Roosevelt by Secretary Taft, says the New York Commercial, that the government has thus early in the construction of the Panama Canal taken hold of the labor issue with firm hand. Briefly, it has peremptorily refused to accede to demands for an advance in wages made by three of the most important classes of canal employes: the steam-shovel men, including engineers, crane-men and firemen, construction locomotive engineers and construction-train conductors.

Secretary Taft points out that these men all took employment on the isthmus, well knowing in advance exactly what their wages were to be and all the conditions and regulations surrounding it; and the reasons why their demands cannot be granted may thus be summarized: Their pay is already from 25 to 35 per cent higher than for corresponding work in the States; every shovelman on the isthmus gets a six-weeks' vacation each year with full pay—something that not one in fifty thousand salary or wage-earners enjoys here in the States; they have an eight-hour day—20 per cent shorter than most of them had at home; in case of sickness every canal employe may get thirty-days' leave with pay—how many mechanics and laborers get such consideration in the States?—and in case of bodily injury while at work the concession is sixty days; and every married man is entitled to good quarters, comfortably furnished, for himself and family, and free.

Organized labor has had tilts without number with all sorts and conditions of employers; "Uncle Sam" is a new-comer in the employing field; organized labor puts out its "best pair of horns" on the Isthmus of Panama to challenge the new-comer. The novice comes off victor in the first "run-in." The government is to be the leader, the "boss," now and henceforth.

Steel Pavements in Paris

Paris is experimenting with the latest thing in pavement. They call it steel pavement, but it is really a concrete pavement reinforced with a steel framework. The trial section of it has been laid on the Rue Saint-Martin, in front of the Conservatoire of Arts and Industries.

The metal part of the pavement is a plate of perforated steel with strong bolts of steel running through it between the perforations. Each section has some resemblance to a steel barrow, only the prongs project equally on each side and they are square and blunt.

The plates are arranged close together on a bed of rough concrete such as is used for wood block pavement. Then a specially prepared cement is shoveled upon them in a soft condition and rammed down until it makes a solid mass, with the steel frame just leveled off evenly with the upper tips of the prongs.

The steel prongs are so close together that the shoe of every horse and every wheel of any width must rest in part on them and in part on the cement. It is expected in this way to secure a highly durable but distinctly uneven surface, one on which horses will have sure footing in all weathers and on which they can secure the necessary purchase to pull heavy loads.

It will be superior to asphalt in ultimate economy and to wood both in the better footing that it affords to horses and in the fact that it will not admit of dangerous ruts developing. The sample laid cost $5.40 a square metre, a little more than a square yard, but when the work is done on a large scale it is believed the price can be cut to about $4.50. The life of such a pavement without serious repairs is estimated at ten years as a minimum.

doors. New patent ventilators now being used by the Union Pacific on its motor cars will be placed on the new coaches and the cars will present an appearance so little in common with the ordinary coach that they will scarcely at first sight be recognized as a passenger vehicle. Some of these new side-door coaches will be completed and placed in actual commission in a few months.

When the great fire swept over San Francisco, a great many of the street cars belonging to the United Street Car Railroad Company were burned. Scores of cars were scattered along the streets, and being rendered helpless, as the power was cut off, were overtaken by the engulfing flames and destroyed.

Damaged rolling stock to be used.

At the car yards out on Valencia Street, the loss proved the heaviest to the company. In the aggregate more than 100 cars—many of them large, new, and expensive—were totally destroyed. The photograph gives a view of the ruins at the Valencia Street yards after the flames had wrought their work of destruction. It was months later before the railway company attempted to do anything with the charred and blackened wreckage. However much of the heavy works have recently been reclaimed, many of the trucks, and much of the gearing is being successfully overhauled, repaired and is now being used as rolling stock. A great percentage of the works were so badly burned as to prove useless and proved an almost total loss—being sold for junk and scrap iron. From the photograph some idea may be formed of the condition in which the ruins were left by the fire.

By a vote of 10 to 1 the City of Los Angeles, Cal., has decided for the bonding of the municipality to the amount of $23,000,000 for the building of an enormous water system, second in magnitude only to that of the Croton System of New York.

The money voted will be expended in the construction of an aqueduct 250 miles in length, which will bring from the Owen's River Valley, in Inyo County a supply of pure water impounded from the melting snows on the easterly side of the high Sierras, and which will amount to a constant flow of 30,000 miner's inches—a quantity sufficient to supply a city of 1,000,000 people.

The water supply project also includes the development of no less than 90,000 horse power of electrical energy, which will be sufficient to furnish all Southern California with all the electricity it needs for whatsoever purpose. This latter part of the enterprise will pay for the conduit, pay for the lands already purchased by Los Angeles, and then leave a sufficient surplus to renew the entire water system of the city.

small stretch of road furnishes much improved grades, and materially lessens the distance into Southwest San Francisco, than over the old route down the Peninsula. In total length the cut-off proper does not exceed nine miles, yet that entire distance has involved continuous, heavy, and very expensive work. Heavy cuts, fills and tunnels have constituted the work from beginning to end.

View of interior of Tunnel No. 5, Bay Shore Cut-off.

Preliminary work on this vast undertaking was commenced about three years ago, and operations have been pushed vigorously at each end, and at several points between, until about June 15 of the present year, when all the work save track laying was completed.

It is estimated that the total cost of constructing this cut-off will approximate $7,000,000. Throughout, the cut-off is double-tracked (including all the tunnels). Work on the last tunnel was completed last November. The entire work was planned under the general supervision of William Hood, Chief Engineer of the Southern Pacific. These plans have been executed under the immediate direction of W. E. Marsh, Assistant Engineer.

Tunnels Nos. 2 and 5, and most of the grading, were done by contract; the remaining three tunnels and all other operations were done by the railroad company under Engineer Marsh. The tunnels are, of course, the greatest picturesque feature of the cut-off. Nos. 1 and 2 are through the Potrero Hills; No. 3 through Hunter's Point Hill; No. 4, the largest tunnel, goes under the high ridge opposite Candlestick Point; No. 5 is through Sierra Point.

Tunnel No. 1 is 1,817.3 feet long, through massive Serpentine rock with clay seams; No. 2 is 1,086.4 ft. long, also through the same kind of rock; No. 3, 2,364 feet long, is in part through wet sand with seams of clay, and in part through very hard silicated formation; No. 4, which is 3,547 feet long, is mainly through very wet ground with quicksand and clay layers, and in part through medium shale; No. 5, 1,138.8 feet long, is through hard sandstone. The total length of these tunnels is 9,948.5 feet, being 1 mile and 884 feet of double-track tunneling.

The average progress in each end of each tunnel was a little over 4 feet a day, or 8 feet a day total progress. No power drills were required except in the hard rock in No. 3. The tunnel sidewalls are of concrete, and the tunnel arch of brick, with three sections, according to material passed through.

The packing between sidewalls and arch-ring and natural material in some cases is broken

Looking out of Tunnel No. 4, Bay Shore Cut-off.

rock, and in other cases concrete. The tunnel excavation of maximum section, including an assumption of six inches all around the masonry, was approximately 32.2 cubic yards per lineal foot.

These tunnels, with the exception of No. 5, were taken out with a center core, being about 18 feet high and about 13 feet wide, supporting the false timbering, and in the progress of

on the Pacific Coast in the history of railroad construction.

The Southern Pacific System is also now carrying forward another immense project in connection with the newly completed Cut-Off. It is the building of the largest terminal and freight yards West of the Missouri river. More than 140 acres of the Bay are now being filled in, and on this will be constructed many large buildings, a vast network of trackage. This great terminal will be located in Visitacion Valley. The total cost of the Cut-Off and this immense terminal, freight yards, etc., will cost the Harriman System many millions of dollars.

RAILROAD NOTES.

The Pennsylvania, through the Frank P. Whitton Co., contractors, has begun work on the construction of a new coal storage yard at Ashtabula Harbor which will embrace eight half-mile tracks and have a capacity of about 500 cars. The addition will represent an investment of about $50,000.

It is estimated that the cost of tramps to the railroads of the country amounts to $2,500,000 annually. They infest every line and are responsible in many cases for railroad wrecks, the burning of depots, great loss of life, and fires in box cars. In order to take revenge on society some of them tamper with switches, interfere with signals, and even kill railroad employes.

The first practical steps are now being taken in connection with the scheme for a tunnel through Mount Blanc. Seven French engineers have recently arrived at Sallanches, on the French side of the mountain, and thirty men are now engaged in pick work rendered necessary by certain preliminary studies and estimates.

Another party of seven engineers is similarly engaged on the Italian side. A great international company has already been formed, having as its head M. A. Monod, the eminent engineer of Paris.

The Nickel Plate Railroad may be called upon by its New York Central owners to solve the problem of through trolley traffic between Cleveland and Buffalo. It is pointed out that [illegible] and suburban passenger business of the Lake Shore could be diverted to the Nickel Plate under a system of combined electric and steam operation, such as that on the West Shore. At the same time the through freight business of the Nickel Plate could be more economicaly handled by transferring it to the fast tracks of the Lake Shore.

At present the passenger traffic of the Nickel Plate on its entire mileage from Buffalo to Chicago is only about $3,000 per mile per annum. The Lake Shore Electric is earning between Toledo and Cleveland over $5,000 per mile per annum. The Cleveland, Painesville & Eastern electric line earns over $10,000 per mile per annum. These figures show the amount of passenger traffic that could be diverted to the Nickel Plate if converted to electric equipment. It would not only make a strong bid against the trolleys for suburban traffic, but would draw largely from the unprofitable short haul business of the Lake Shore.

In the early days of railroading, say in the '70's, there was a wood pile every few miles along the road. The engines used only wood, and when they came to one of the wood piles the engineer and fireman would climb down and fill up the tank.

There was about as much difference in pay those days. The engineer got $2 and the fireman $1, and there was no such thing as overtime. The day ended when the end of the road was reached. They could not get water in the boiler unless the engine was moving, there were no such things as injectors or inspirators. There was a pump and it was attached to the guides of the drivers, so that unless they were moving there was no way to pump water in.

Repairs added to the burden. An engineer was suposed to make his own repairs. Of course, he couldn't be expected to do that now, the machinery being so much more complex. The fireman used to crawl under the engine and pack the wheels. If anything went wrong there, it was his fault.

There didn't use to be any safety devices, like the steel brake beam or the air brake. And the hand brakes were poor. It was not a bit unusual for one of these wood brake beams to give way and wreck the train.

An engine was not rated in horsepower or the diameter of the drivers, but according to the number of cars it could pull, whether they were loaded with straw or brick.

Showing extreme angle of tip.

the upper; in this way together with numerous locks, this great engineering project was ac-accomplished; the details of construction, however, were far more difficult, in fact, it was a most stupendous task. As this undertaking was completed before the days of special machinery which has now revolutionized the methods of similar construction, each foot of this wonderful canal was a product of manual labor; the "sweat of the brow" with pick and shovel and wheel-barrow; each piece of masonry was dressed and set by hand, and truly, no undertaking was ever carried on under more difficult and trying circumstances, the whole being executed by "Brawn."

How differently this undertaking would be carried on at the present time, with the modern appliances; using the gigantic steam shovels of our day for the excavation; and trains of the large pneumatic dump cars, carrying in the neighborhood of 35 cubic yards of material each; hauled by one of our modern locomotives to the dump and discharging the entire contents of 500 cubic yards or so, by the turning of a single valve; dispensing largely with the item of labor in which there are so many disaffections, relying almost entirely upon those wonderful mechanical implements that are imbued with nearly the spirit of human intelligence; constructing the banks upon the different "levels" as they now employ these cars to fill the trestles of our present day railroad construction, diminishing with these facilities, the engineering work, and providing a water-way with a less number of levels, fewer "inclines" and locks, simplified in its construction. It would certainly be more economical in its operation and better adapted to become of enhanced value; a monument to the enterprise of its state ownership; instead of its deterioration to a dirty, muddy sluice-way of sewerage! Even now, the reconstruction of this water-way might again come into commercial prominence and competition with the paralleling railway; with the abundance of water power that may be generated throughout almost its entire length, for the application of electrical traction and a reconstruction of the water-way, providing fewer and longer "levels," fewer inclines and

struction, the buckets are subject to a side movement before being tilted to dump; the angle made by the floor, when in this dumped position, is considerably steeper than is found in most dump cars, nearly 50 degrees from the horizontal, so as to insure complete discharge of the entire contents; it is claimed that all the material, of any character, will be discharged from this car upon the single application of the air power.

The relative efficiency of this car, considering the weight of the material contained, as compared with the total weight of the loaded car is considerably more than usually found, carrying, generally, when fully loaded, nearly 42 cubic yards, and assuming that the average cubic yard, thus loaded for transportation, will weight about 3,000 pounds, the total load would approximate 125,000 pounds—the weight of the car, when empty, being 58,700 pounds, a total load upon the rail will then amount to nearly 184,000 pounds, of which 125,000 is the weight of the material contained, or 68 per cent of the locomotive's power, utilized in the hauling of the material.

The great strength and consequent durability of these cars may be judged from their weight, insuring their long and continued service in the employment of the contractor, with little or no repairs, beyond those of ordinary wear and tear.

As the requirements of general railway undertakings have produced a decided demand for a car of similar construction, capable of discharging its entire load upon either side of the track, The Lawson Car Co., is preparing to place a number of new cars upon the market, to fulfill this particular service. The experimental car has been successfully "tried out," under the most adverse circumstances and has developed a number of new and valuable qualities heretofore unprecedented. The car is to be of 80,000 pounds capacity and carrying about 20 cubic yards, bank measure or 28½ cubic yards, loose measure, when loaded, and weighing about 41,000 pounds, empty, deriving a relative efficiency of the weight of the material, as compared with the total weight of loaded car, equivalent to about 65 per cent of the pulling power of the locomotive. One of the important features that has been developed in this single box car, has been its great stability when dumping or discharging its load, producing no lifting of the wheels from the rail or excessive jolting of the car. The floor, when in the dumped position, assumes an angle of 52½ degrees from the horizontal; this car has been safely dumped while traveling at a speed of 20 miles an hour.

The above information was furnished by the Lawson Car Company and Mr. John W. King, Park Row Bldg., New York.

Clark Traction Trencher.

THE digging of ditches by machinery is becoming much more common as the number and length increase. To dig, elevate and convey to side of ditch is the object of designers of this machinery. The machines of the Clark type are self-propelling under steam at the rate of 2 to 4 miles per hour over ordinary country roads when being transferred from job to job or by folding up the elevator and taking off the smoke stack they can be placed on a flat car.

The three sizes of Clark trencher cuts from 28 to 60 inches and weigh 10, 12 and 16 tons respectively. The engines are from 16 to 25 H. P. and the mechanism thoroughly built so to take the strain of handling 30 to 80 cubic yards per hour. The elevators are arranged to throw the dirt either to the right or left side and as the cutting proceeds the machine is advanced.

The weight on the big wheels is at least 3 feet from the trench so there is no danger of a cave-in, and pipe may be laid within 2 or 3 feet behind the machine; this avoids the use of sewer braces except where the soil is very soft.

Only two men are required to operate the machine—an engineer and fireman, the latter attending to the adjustment of the elevator leg.

When trenching along a street and such obstructions as water and gas pipes are encountered the elevator leg is raised and a cut made over the pipe and the machine is allowed to dig down and backward under the pipe. This avoids the hand shoveling, common with some machines.

To excavate earth with pick and shovel and load it, will cost about 40c per cubic yard, for hard pan; 20c for tough clay; 15c for ordinary clay, gravel or loam and 12c per cubic yard for light sandy soil—wages being reckoned at 15c per hour, but with a traction ditcher it may run as low as 4c per cubic yard.

A Labor-Saving Machine.

IT has ever been man's aim to make and utilize any machinery which tends to decrease labor and increase output, and today there is hardly any article manufactured, or laborious occupation carried on but what there is more or less extensive machinery used to facilitate the same.

This principle also applies to the development of the coal producing industry, and today coal can be mined, hoisted and loaded almost automatically. One of the greatest labor saving machines in this line to be put on the market in the past decade is a Box Car Loader, manufactured at Ottumwa, Iowa, by the Ottumwa Box Car Loader Co. By using this machine, operators have been able to do away with the services of from four to twelve men whose occupation has been the throwing of coal from the center to the ends of the car.

The accompanying illustrations will give a very good idea of the shape and design of this machine, but a short description of the operation will be an aid toward a more intelligent understanding by the reader.

The coal is dumped down gravity chutes, and delivered into a hopper, or carrier, which sets on the end of the main frame of the machine, and which, when a car is ready to load, is run into the car. This carrier is run alternately to one end of the car and then to the other, and in its motion past the chute or apron, delivering the coal to the car it receives its load of coal. As soon as the motion of the hopper toward the end of the car is complete, a traveling end gate pushes thru, carrying the coal out to the end of the car. This operation is then duplicated in the other end, and so on

The Ottumwa Box Car Loader.

alternately until the car is loaded. The machine is then backed out under its own power, the car run down the track, and a new one run into its place. The machine also has a car pulling attachment, by the use of which a string of from two or three to twelve or fifteen loaded cars may be switched either up or

Showing position of loader in car.

yards of earth and rock have been excavated —one-fourth the estimated yardage of the Panama canal.

Director Newell declares that valueless land, when reclaimed by irrjgation, will sustain one person to the acre. In relating his experiences, he declares that the most interesting was the discovery of water within 15 feet of the surface in the Nevada desert, which for 40 miles is covered with the bones of men and animals who perished because they were unable to find water.

The Deep Waterway Project.

The government project to connect the Great Lakes with the Gulf of Mexico by a deep water-way carries with it a solution of the whole vexatious puzzle of equitable transportation rates, and points a way to the quicker development of the whole country in every line of industrial enterprise or agricultural pursuit.

It is one of those rare questions of public policy free from any suspicion of politics or "graft." It is plain matter of business touching the prosperity of the country as a whole, and the individual profit of every man, whether he be a laborer, mechanic, farmer, merchant or millionaire.

The completion of such a waterway means *cheap transportation* for the millions of tons of products from this vast territory. It means a great public highway of unlimited capacity, giving direct connection between our fields and factories and the great markets of the world.

The "divide" between the Great Lakes and the valley of the Mississippi has been cut through by the Chicago sanitary and ship canal, having a minimum depth of twenty-six feet. This section alone, is the greatest artificial waterway in the world. It was built twice as large as was necessary for sanitary purposes, in anticipation of the present project to continue the work until tide-water is reached. That which remains to be done is simply the task of improving natural existing waterways of river channels.

The Mississippi Valley presents no unsolved problems, from an engineering standpoint. Millions of dollars have been expended by the general government and private corporations in experimental work. There is no longer any problem. The building of levees is simply a matter of time and money. The channel improvement is only a question of dredging by modern machinerv.

As the nineteenth century was the age of railroads, the twentieth century will be the age of waterways and canals. In his process of development man has always followed the easiest lines of transportation. The pendulum, therefore, is swinging back, and the improvement of natural waterways and the building of canals to connect natural lines of water communication are the great problems now occupying the commercial world.

Here in the United States, where railroad construction and operation have reached a high state of efficiency, it costs on an average 7.5 mills to move one ton of freight one mile. On the Great Lakes, where the connecting canals afford a depth of twenty feet, the average cost is .92 mill, and on the Lower Mississippi and Ohio, where barges are used, the cost ff carrying heavy freight is reduced to .1 mill per ton per mile. On the Erie Canal—a mere ditch—the cost of moving freight is but 1.9 mills per ton per mile, and when the present plans for a 12-foot depth are completed the cost will be reduced to less than one mill.

The fear that canals may supersede the railroads is not only groundless but it has been established as a fact that where railroads and canals compete as common carriers the result has invariably been that the tonnage of the former has been largely increased. The waterways through the Great Lakes made Chicago the greatest railway center in the world. The barge has not superseded the freight car. Both these means of conveying freight are thriving, not only around the Great Lakes, but also along all the great water courses and the Atlantic sea coast. The waterway furnishes the more economical means for carrying the slow and bulky products of the forest, mines, farms and furnaces; the railroads provide the most rapid means for transporting the costly and finished products of the loom, mill and factory.

On the Erie Canal the cost of transportation is 1.9 mills, but upon the deepening of that waterway to 12 feet the expense will be reduced to, approximately, half a mill. Col. John L. Vance, president of the Ohio River Improvement Association, said in an address recently delivered that "the heavier freight"—coal, iron, steel, locomotives—"are today carried on the Ohio and Lower Mississippi for one-third of a mill per ton per mile—a less figure than any other waterway in the world. These figures include the return of empties

Two Flory Cableways on a Dam across Snake River.

to transfer it from one bank to the other and put it in cars or bins. The expense saved in rehandling the sand is an important item when compared with pumping it into a barge which must be towed to the shore and unloaded. The labor, and frequently delay in getting proper anchorage, are too obvious for discussion.

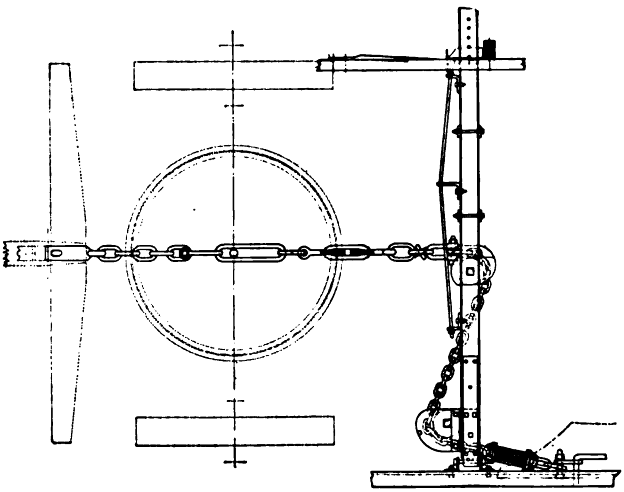
The capacity per day is limited by the size of bucket and, to a certain extent, the length of the span. A daily capacity from 400 to 600 cubic yards is readily obtained where the conditions are favorable for the bucket to fill and discharge.

Modern Machinery for Earth Moving.

THE very large amount of railroad construction at the present time going on in the United States presents many interesting problems for the engineer and for the contractor. Not only are the existing steam railroads extending their lines, particularly in the west, but the number of interuban electric roads in course of constuction or contemplated is very large. Many miles of such steam and electric roads are being built through rolling country, and which call for the making of large cuts and fills.

Fifteen or twenty years ago the aim of the constructing engineer was, how cheap a road could be built, and not, as at the present time, how good. Nowadays many millions of dollars are being spent for the elimination of grades and for the double tracking of lines, proving that the ideal of the engineer is far different now from what it was when railroad building in the United Staes was in its infancy. The reduction of grades necessitates the moving of many more yards of earth than was the case when the line of railroad was determined, not by the shortest distance between two given points, but by the cheapness with which it could be constructed. As a result the mechanical ingenuity of the builders of earth-handling machinery has been called into requisition, with the result that in the year 1907 earth can be moved cheaper and quicker than ever before. The purpose of this article is not so much to indicate the method of constructing a line through rocky country, but to have something to say about machinery which can be successfully employed in moving earth where rocks are conspicuous by their absence.

Perhaps the most efficient earth moving machine so far used is an elevating grader. It must, of course, be understood that this machine is not suited for work where large stones are encountered nor where root grubbing has not been done. For cheaply and efficiently moving the ordinary prairie soil which is encountered in almost every section



Plan of Elevatting Grader showing Plow.

tween the bottom of the doors when they drop and the ground, and also because the height of the wagon from the ground should be as little as possible, so that they can conveniently be drawn underneath the carrier of the grader. This heavy draft difficulty was overcome by the inventor of the National dump wagon, who hinged his doors in such a way that they slide up the outside of the wagon box when the load is dumped, instead of dropping straight down to the ground. In this way the capacity required could be obtained without increasing the height of the wagon, and at the same time it could be coupled short and thus made of light draft. This swinging up of the doors is shown in the illustration, and is a feature much appreciated by practical railroad contractors.

It is not only for railroad building that an elevating grader can be advantageously used, but also for constructing improved earth roads in territory where heavy cuts have to be made and where stone for macadam is scarce. Roads thirty to forty feet wide, properly crowned, and with ditches on each side, can be built at a very low cost when an elevating grader is used. The earth is excavated from the two sides of the road and thrown to the center, and is then packed down by either a horse or steam roller.

In many of the eastern states roads are being re-located with a view of doing away with heavy grades that often exist at the present time. Hills are being cut down and hollows filled out, so that teams can haul much heavier loads with less exertion than was formerly the case. Elevating graders and dump wagons can be employed to good advantage, and highway builders are coming to see what a saving can be effected by the employment of these machines.

The guaranteed capacity of the National elevating grader is 1,000 cubic yards of earth per day deposited in embankment or loaded into wagons, but under favorable circumstances

National Dump Wagon dumped.

[illegible] yards or more can be moved in [illegible] work when a traction engine is [illegible] Twelve horses, eight in front and four [illegible] will average 1,000 yards of earth per [illegible] in and week out, and a twenty or [illegible] horsepower traction engine will [illegible] from 1,200 to 1,500 yards every day [illegible]

[illegible] average cost of moving ordinary earth [illegible] it in embankment by means of an [illegible] grader is 2½ to 3½c per cubic yard, [illegible] dump wagons are used and the haul [illegible] does not exceed 1,200 feet, 9c per [illegible] is a conservative estimate of cost. [illegible] is a subject which will bear the [illegible] investigation from all earth moving [illegible] and also from highway builders. [illegible] scarce and commanding high wages, [illegible] demands that the most modern [illegible] economical machinery be employed, so [illegible] cost either of building steam and [illegible] railways or of highway construction, [illegible] brought down to the lowest possible [illegible]

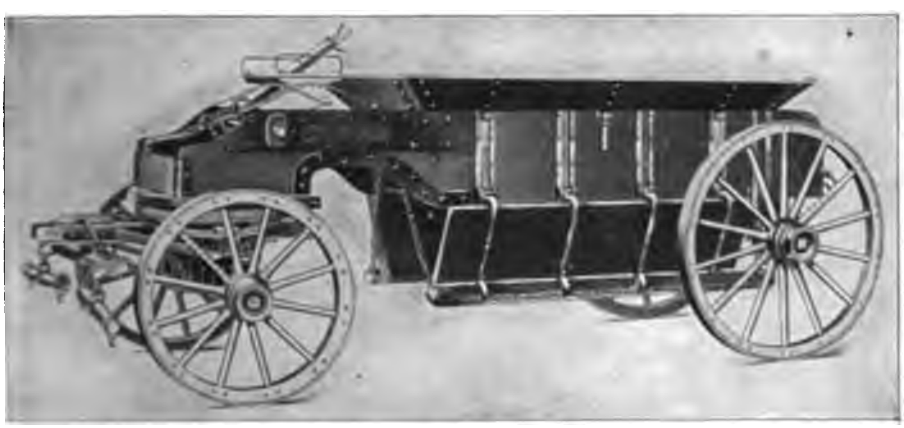
The New Studebaker Dump Wagon.

SINCE the Studebaker Vehicle Works [illegible] its beginning, fifty-five years ago, [illegible] a country blacksmith shop at South [illegible], it has never been their policy to [illegible] President J. M. Studebaker said, [illegible] address last summer, that he never [illegible] seen the time when he could say he [illegible] satisfied- and he never expected to see it. [illegible] been this constant endeavor to do things just a little better that has been largely instrumental in maintaining the high standard of efficiency and quality of all Studebaker products and in building up their immense business.

This policy of constantly striving to produce something better is apparent in every department of the Studebaker plant, and in no part of the factory is it more noticeable than in the branch of the business devoted to the manufacture of dump wagons. For several years past they have been making an exhaustive study of the dump wagon question, and, as a result, are today able to offer to contractors a dump wagon that satisfies every requirement of modern methods.

Many contractors have learned, to their cost, that the dumping mechanism is not the only important part of a dump wagon. The finest dumping attachment ever invented in connection with a poorly constructed gear would be a disappointing failure. So, in the first place, the wheels on the Improved Studebaker Ideal are built to stand up under the hardest kind of wear. The front gear has full circle oscillating fifth wheel. This permits the front wheel on either side to drop into a depression or run over an obstruction without disturbing the level of the body. The load is drawn directly from the front axle, instead of from the hounds—a most worthy improvement. The coupling, consequently lighter draft, and also insuring clearance, making it impossible to stall a team on the dump.

The dumping attachment is operated from the driver's seat. It is very simple, and absolutely positive in its action. A chain is at-



Side View of Studebaker Dump Wagon

tached to the front roller, and passing down over rollers to one of the trap doors, follows along its entire length; thence over roller and pulley attached to the rear end of bed along the full length of the other door and back again to the front roller, making practically an endless chain. One end of this winding upon a slightly larger roller circumference than the other, closes one door in advance of the other.

The bottom doors are covered with a high quality of heavy sheet steel. Over the inside edge of the trap door closing first, this steel projects about 1½ inches, so that when the doors are closed this projection laps over the other door, effectually closes the opening, and makes a tight bed that will not leak. By the use of the endless chain device for closing the trap doors all necessity for adjustment of any kind is avoided, and the doors are always tightly closed. Attached to the dumping lever is a safety device, making it impossible to accidentally dump the load.

Rear View of Wagon.

The trap door sills are made of heavy angle iron, and underneath them passes the endless chain. Metal loops serve to retain the chain in place. The trap doors are suspended by four heavy hinges on each side. The body is made of well-seasoned, bone dry, hard wood.

The Improved Studebaker Ideal dump wagon is made in two sizes, 1½ and 2-yard capacities, respectively, stroke measure.

The South is now making more than four times as much iron as the United States made in 1860 and nearly as much as the entire country made in 1880.

Improvised Method of Excavating.

IN making the excavation for the First National Bank building on Euclid avenue, Cleveland, it would be very difficult for horses to pull a wagon load of dirt up the steep incline afforded, and the dirt is consequently hoisted in an improvised method.

The dirt is shoveled by hand into a wooden box containing about ½ cu. yd. A hoisting engine then transports it by means of a 100 ft. beam to the wagon, which is backed on to a narrow staging. The driver and laborer then empty the box through one end which is open, by taking off the rope from that end.

Test of a Dump Wagon.

FOUR tests were made in the Purdue Laboratory for Testing Materials, and, in brief, the objects of the tests were as follows:

First—To ascertain the maximum or breaking load which the complete wagon would sustain.

Second—To ascertain the resistance of the rear wheel against the strain that occurs when the wagon is tilted sidewise on a slope so steep that it is about to overturn.

Third—To ascertain the resistance of the rear wheel against the strain that occurs when the wheel is caught in a rut, and the horses attempt to turn it out of the rut.

Fourth—To ascertain the strength of the rear axle when loaded at the bearings of the springs and supported in the hubs.

For the purpose of these tests, a Troy Bottom-Dump Wagon, No. 5½, taken out of stock by the manufacturers, the Troy Wagon Works Company, Troy, Ohio, rated as capable of safely carrying 8,500 pounds, or 4¼ tons, was used. The total weight of the wagon as tested was 2,410 pounds, or 1.2 tons. Of this weight 1,211 pounds was on the front end, as tested, and 1,199 pounds on the rear end. The weight of the body of the wagon was 1,386 pounds. The rear wheel was 4 feet 5 inches in diameter; width of tire, 4 inches; spokes, 2¼ inch size; hub, 9½ by 11½ inches; material, white oak. The wheel weighed 208 pounds.

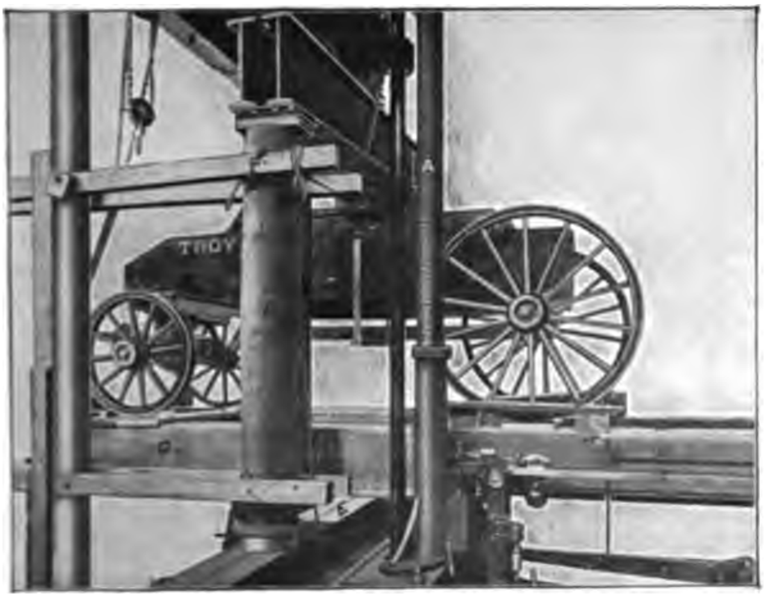


Fig. 1—Side view of wagon under test.

The test on the complete wagon developed the fact that it sustained a load of 72,500 pounds, or 36¼ tons, before it broke down. When failure did occur, it was not in the wheels, but in the body of the wagon, and was accompanied by a slipping of the side boards along each other, and by a yielding of the [illegible] fastening the steel neck plates to the side boards.

In order to make this loading test, the wagon box was filled with sand, and the load was applied to the sand by mounting the wagon in a large testing machine, as shown in Figures 1 and 2.

Since the wagon was too large to place directly into the testing machine, a steel girder, E, was placed across the weighing platform of the testing machine. The wagon, mounted longitudinally by wooden joists, G, was set up on one projecting end of this steel girder. The load from the testing machine was applied to the wagon through a straining beam, B, supported at one end on a wooden prop, D, that rested on the other end of the steel girder E. The load came on the surface of the sand, which was filled in the wagon box to the level of the sides. It was distributed over the surface of the sand by blocks and sills. The straining beam and sills did not touch the sides of the body. The load went down to the bottom of the box through the sand, except for such part as went directly into the sides through the friction of the sand.

In Figures 1 and 2, A is the vertical screw of the testing machine, which brings down the straining head, C, on the straining beam, B. This load is carried one-half to the prop, D, and one-half to the wagon through the straining beam. The total load on the straining beam is weighed on the weighing platform of the testing machine, and is indicated on the scale beam, F.

The loads given in Table 1 are not the total loads on the testing machine, but the actual loads carried by the wagon.

The loads were applied in steadily increasing quantity, and were released at intervals to obtain the set of the parts of the wagon until failure occurred.

MEASUREMENTS TAKEN.

In order to determine the amount of yielding of the parts of the wagon during the test, the following measurements were taken:

(*a*) The dimensions of the top of the box before

(*b*) and after test.

(*c*) The widening of the opening in the body at the bottom of the neck.

(*d*) The amount of sag of the bottom of the box at the center of the bottom. This is measured with reference to the sides of the body.

(*e*) The deflection of the sides of the body with reference to the fixed points on the sides over the axles. The sides act as girders, carrying the load to the axles, and this measurement represents the deflection of the girder.

(*f*) Downward movement of spring on rear axle.

(*g*) Deflection of rear axle below line drawn between hubs.

(*h*) The entire downward movement of the wagon body with reference to the bottom of the wheels.

(*w*) The change of diameter of rear wheel.

The results and log of test are set forth in Table 1 and Diagram 1.

The successive loads and deformations are given in all detail and are sufficiently descriptive. The main events of the test may be summarized thus:

Load Lbs.	Load Lbs.	
40,500	20.25	Front bolster down on arches.
44,500	22.25	Side boards of body slipping along each other, due to bending of body.
48,500	24.25	Side boards cracking at neck.
62,500	31.25	Sides down on rear hubs.
72,500	36.25	Rivets sheared in neck plate.

As the capacity of the wagon is figured as 8,500 lbs., the factor of safety against dead load is 72,500 divided by 8,500 or 8.53.

The wheels, axles and bolsters showed no signs of failure. The chains were intact. The bottom of the box had sagged 4.37 inches, but did not leak sand under the test. The dumping mechanism worked after the test and dumped the load.

The springs over the rear axle were uninjured. These springs serve a useful purpose in absorbing the severe jars and jolts which arise in service. They thus lead to a greater life of service of the wagon than would be the case in the absence of such springs.

TABLE I.

Log Sheet of Test of Troy Dumping Wagon.

REMARKS OF FAILURE	Net load on wagon	Deformation of Parts.						
		c	d	e	f	g	h	w
	lbs.	ins.	ins	ins.	ins.	ins.	ins.	ins.
	0.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1,000	0.00	0.00	0.00	0.01	0.00	0.05	0.00
	2,000	0.00	0.04	0.00	0.01	0.01	0.05	0.00
	3,000	0.02	0.05	0.01	0.02	0.01	0.07	0.00
	4,000	0.02	0.10	0.07	0.03	0.01	0.10	0.00
	5,000	0.03	0.14	0.07	0.04	0.01	0.0C	0.00
Set R	0.000	0.00	0.10	0.01	.....	0.00	0.00	0.00
	0.000	0.01	0.10	0.04	.....	0.00	0.00	0.00
2 " "	6,000	0.03	0.20	0.08	0.05	0.01	0.08	0.00
	7,000	0.05	0.25	0.13	0.08	0.01	0.10	0.00
	8,000	0.0	0.30	0.16	0.10	0.02	0.08	0.00
	9,000	0.05	0.35	0.17	0.11	0.02	0.15	0.01
	10,000	0.0	0.40	0.18	0.14	0.04	0.17	0.01
Set R	0.000	0.03	0.20	0.08	.....	0.00	0.08	0.00
	11,000	0.03	0.?0	0.20	0.21	0.04	0.21	0.01
	12,000	0.05	0.54	0.25	0.23	0.05	0.25	0.01
	13,000	0.05	0.59	0.27	0.27	0.05	0.28	0.01
	14,000	0.06	0.64	0.29	0.29	0.06	0.31	0.02
	15,000	0.06	0.70	0.30	0.31	0.07	0.35	0.02
Set R	0.000	0.03	0.35	0.16	......	0.00	0.08	0.01
	17,000	0.06	0.89	0.37	0.36	0.07	0.40	0.02
	19,000	0.06	0.95	0.43	0.42	0.09	0.50	0.02
	21,000	0.07	1.05	0.47	0.48	0.10	0.55	0.03
	23,000	0.07	1.17	0.56	0.55	0.10	0.65	0.03
	25,000	0.08	1.30	0.62	0.64	0.12	0.75	0.04
Set R	0,000	0.03	0.78	0.28	......	0.00	0.24	0.04
	27,000	0.09	1.50	0.67	0.71	0.14	0.86	0.05
	29,000	0.10	1.55	0.75	0.81	0.17	1.01	0.05
	31,000	0.10	1.60	0.79	0.93	0.19	1.11	0.05
	33,000	0.11	1.80	0.89	1.08	0.22	1.25	0.06
	35,000	0.11	1.90	0.98	1.25	0.29	1.41	0.06
Set R	0.000	0.07	1.30	0.47	0.64	0.10	0.61	0.06
Front bolster down on arches........	37,000	0.14	2.21	1.09	1.36	0.29	1.61	0.07
	39,000	0.16	2.30	1.17	1.39	0.31	1.71	0.08
Sides of box shearing along boards	41,000	0.21	2.40	1.27	1.46	0.35	1.81	0.08
	43,000	0.18	2.60	1.37	1.51	0.37	1.96	0.10
Side boards cracking at neck	45,000	0.22	2.73	1.57	1.61	0.41	2.03	0.10
	47,000	0.23	2.87	1.66	1.66	0.42	2.21	0.11
	49,000	0.25	3.05	1.77	1.74	0.44	2.34	0.11
	51,000	0.27	3.19	1.90	1.83	0.44	2.51	0.11
Set R	0,000	0.18	2.55	1.15	1.16	0.21	1.19	0.11
	53,000	0.30	3.55	2.17	1.97	0.46	2.73	0.13
	55,000	......	3.70	2.47	2.09	0.50	2.96	0.14
	57,000	......	3.83	2.56	2.14	0.52	3.01	0.15
	59,000	......	3.97	2.67	2.21	0.53	3.13	0.15
Sides down on rear hubs.........	61,000	......	4.05	2.89	......	......	......	......
Sliding of side boards	63,000	......	4.20	3.47	......	......	......	......
	65,000	......	4.37	3.79	......	......	......	......
	67,000					......	......	......
Rivets sheared in neck plate next to butt'g, both sides.......	69,000	Maximum Load.				......	......	......

Note—For gross load on wagon add to net load 3.500 lbs.

Sand...2700 lbs.

I Beam .... 350 "

Platform, plates and roller............... 450 "

Total..3500 lbs.

NOMENCLATURE.

c—Widening of neck. d—Sagging of bottom of box at center of box. e—Vertical sagging of sides of box with reference to fixed points over the axles. f—Deflection of spring on rear axle. g—Deflection of rear axle. h—Whole vertical movement of wagon with reference to bottom of wheels. w—Change of diameter of rear wheel.

safety under ordinary working conditions will be largely in excess of 2.05.

TABLE NO. II.

Test of Rear Wheel from Troy Wagon, No. 5½. Force applied on rim at right angles of plane of wheel. Axle held solid.

Load on Rim. Lbs.	REMARKS
4,000	Slight cracking.
4,500	Spokes giving in hub.
5,000	
5,150	Spoke slipped in hub.
5,400	Spoke cracked.
5,500	Five spokes lifting out of hub.

When the horses attempt to turn it out of the rut. The rear of the wheel in service is held firm in the rut and the draft applied to the axle twists the hub and spokes against the resistance of the rim. The spokes break or pull out of the hub.

The method of testing is shown in Figure 4. The rim of the wheel was held solid in a large clamp, C, attached to the upright of the testing machine. The weight of the wheel rested on rollers, R, and the rim free to move at the support, but not at the clamp. The loads were applied at right angles to the axle by the straining head of the testing machine at P. In service the rim is held in a

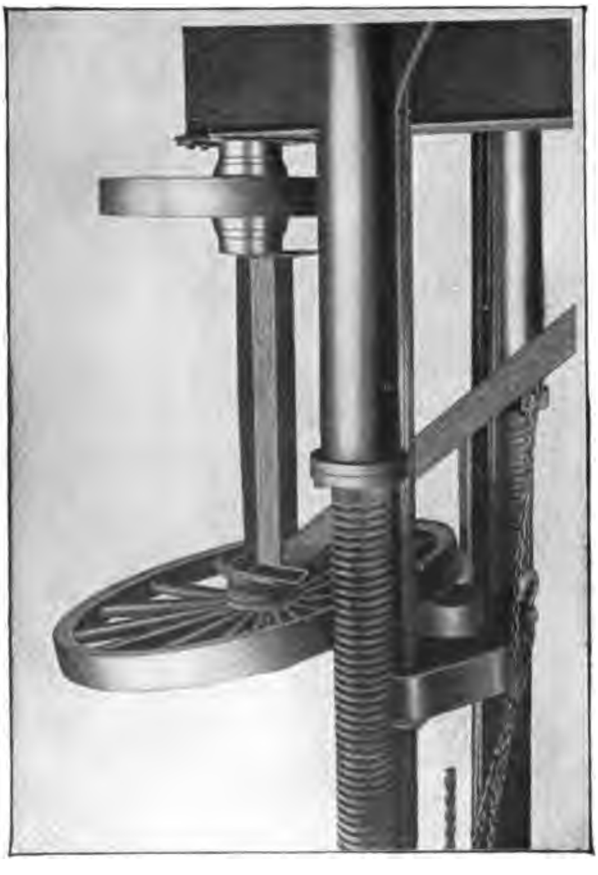


Fig. 8.

After the test the twist of the wheel was 5 inches movement at the end of spoke.

The third test was made to determine the resistance of the rear wheel of a Troy Dumping Wagon against the strain that is brought about when a wheel is caught in a rut and

horizontal clamp (the rut) and the loads (the draft) applied horizontally. In the test the clamp is vertical and the load is vertical. The action on the wheel is the same in each case. The leverage of the load was 43 inches from the center of the hub.

[illegible] were applied increments as shown in [illegible] No. 3 and the amount of the twist of [illegible] with reference to rim was measured. The [illegible] movement was almost entirely in the [illegible] and only very slightly in the rim.

TABLE No. III.

[illegible] of Rear Wheel from Troy Wagon, No. [illegible] Rim clamped solid and force ap[illegible] at right angles to axle in direction of [illegible] at leverage of 43 inches.

[illegible]	Twist of Wheel End of Spoke. Inches.	REMARKS.
0	0.00	
500	0.17	
1,000	0.31	
1,500	0.46	
2,000	0.61	
2,500	0.83	
3,000	1.14	
3,400	1.64	Spoke giving in hub.
3,650 Max.	1.99	Spokes giving in hub and rim.

As shown the maximum load was 3,650 [illegible], with an accompanying twist repre[illegible] by a 2 inch movement at the end of the [illegible] The upper spokes yielded more than [illegible] lower spokes, since the latter are strength[illegible] by the dish of the wheel.

This load of 3,650 pounds, acting with a leverage of 43 inches, gives a moment of 13,080 feet pounds. Now, if the horses were to turn at right angles to the body of the wagon, their leverage would be 9½ feet, since that is the distance from the center of the king bolt to the center of the rear wheel. The draft of a pair of heavy horses will probably not exceed 800 pounds under the most favorable circumstances, hence the moment would be 800 x 9½, or 7,600 feet pounds. The factor of safety against this strain is, therefore, 13,080 divided by 7,600, or 1.72.

It is, perhaps needless to add that conditions so severe as this never occur in the use of wagons; for one wheel of a wagon is never clamped by a rut as firmly as it would be in a vise. Moreover, when one wheel is in a rut, the other wheel is ordinarily in another rut, so that the strain due to turning out is distributed over two wheels instead of being concentrated on one.

The purpose of the fourth test was to determine the strength of the steel rear axle from Troy Dumping Wagon, No. 5½, when loaded at bearings of the springs and supported in the hubs. The axle acts as it does in the wagon and is loaded and supported at the same points. The axle was of steel 2½ x 2½ inches, square in cross section.

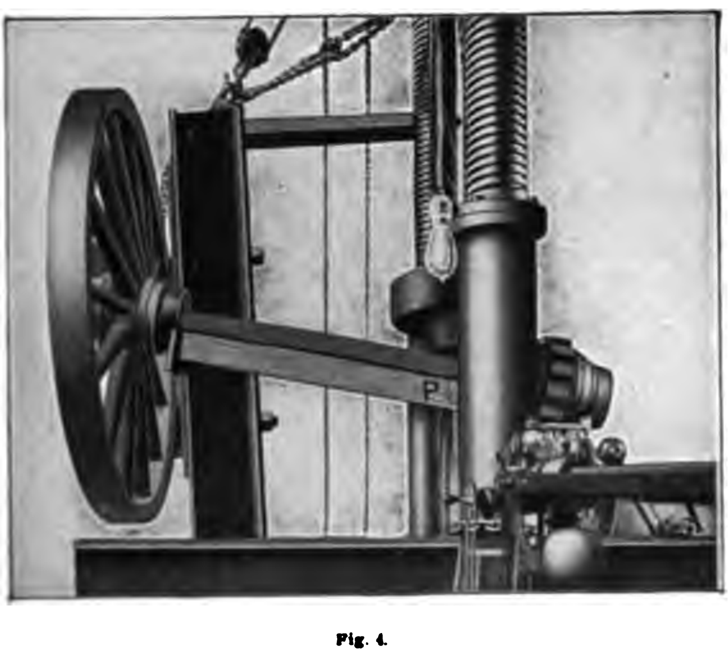


Fig. 4.

Tree Wagon as in regular use.

Hubs from which the spokes had been removed were mounted on the ends of the axle and were supported on rollers at the centers of the spokes. The rollers allow the hubs to move freely in and out and allow the axle freely to take the deflection under the load. In other words, there was no [illegible] action in the axle. Thus supported two loads were applied to the axle at the [illegible] [illegible]. The span between bearings [illegible] was [illegible] feet [illegible] inches. The loads [illegible] feet [illegible] inches [illegible]. That is each load was [illegible] feet [illegible] inches from the center of the axle.

The [illegible] of the test [illegible] shown in Table No. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] a maximum [illegible] [illegible] [illegible].

Table No. [illegible]

[illegible]

[illegible]

Load lbs.	Deflection				
1,000	[illegible]	[illegible]	[illegible]		
2,000	[illegible]		[illegible]		
3,000	[illegible]		[illegible]		
4,000	[illegible]		[illegible]		
5,000	0.08		22,000	0.33	
[illegible]	0.10		24,000	0.37	
8,000	0.12		26,000	0.43	.04
10,000	0.15	[illegible]	28,000	0.55	.15
12,000	0.18		29,650	1.20	

31,000 Maximum load

Description of failures. At 20,000 lbs. axle [illegible] [illegible] [illegible] [illegible] 3 inches from load [illegible] [illegible]. At [illegible] pounds axle buckled [illegible].

Respectfully submitted,

Signed W. K. Hatt

Paper Kettles for German Army

[illegible] are being made to furnish the [illegible] army with paper kettles, [illegible] a Japanese invention. Although [illegible] are made of [illegible] paper, [illegible]. By pouring water [illegible] over the fire without [illegible] time sufficient to [illegible] can be used about [illegible].

[illegible] A. D. 23, but [illegible] was lost and not [illegible].

Portable Railway on Contract Work.*

BY ARTHUR REICHE.

WHILE the standard gauge railways in this country are superior in every respect to this in other parts of the world the narrow gauge and especially the Portable Railway is not used to a great extent in America. I have made many investigations to ascertain why such railways are not more used in this country, and the details that I obtained have convinced me that the contractors in America are not familiar with the advantages of this system of conveying, for portable railways can be used here even to better advantage than in Europe, because wages and the cost of maintenance of draught animals are generally two or three times higher and there is a greater scarcity of laborers.

It is true that in the United States narrow gauge railways equipped with locomotives and heavy box dump cars running on rails of 30 to 75 lb. are used, but only to transport very heavy quantities of material, while on the other hand the transportation of smaller quantities is done practically everywhere by means of scrapers, wheelbarrows and dump carts. The country in which narrow-gauge and portable railways are used to the greatest extent is Germany, and everyone who has traveled much there will be observed, even in the large cities, the portable track with dump cars of different types used to advantage for dirt and materials, for sewerage work, paving, railway and bridge construction, the excavations for large buildings and concrete works of all description. I am convinced that this system of transportation can be used to the same advantage in this country, and have some practical data in support of this decision.

Messrs. Dodge and Day, consulting engineers, Philadelphia, who devote their attention to the betterment of industrial plants, have given me comparative data for the construction of a siding, part of which has been built with wheel scrapers and the other part with portable track and cars. The work done was grading on a spur being built for the Pennsylvania R. R. Company near Homewood, Pa. About 25000 cu. yd. of earth was moved, approximately two-thirds of it being moved with portable railway and the balance with wheel and dray scrapers.

The wheel-scraper work was nearly all borrow-pit work, and the soil was good average earth, easily plowed with a three-horse grading plow. The haul was from 150 to 450 ft., averaging 350 ft. The labor prices on the scraper work were as follows for 10-hour day, No. 3 Western wheel scrapers being used, the number being varied to suit the haul· Two-horse team at $5, three-horse snap team at $7.50, three-horse plow at $7.50, foreman at $3, two scraper loaders at $1.75.

The car work was in a wide cut and borrow-pit averaging 5 ft. in depth; about one-third of the material was hard gravel clay which could be plowed only with a three-horse rooter plow. All material was plowed. The average haul was about 650 ft. Koppel's 24-in. gauge portable track with rolled steel ties was used. Temporary spur tracks were laid over the cut and the plowing was done on both sides of them. The Koppel standard double side dump cars were used in two trains of four cars each of 1 cu. yd. capacity. This load was easily plowed by one horse.

The dump-car track was on a light trestle constructed of round timber, cut in the vicinity and averaging 20 ft. in height.

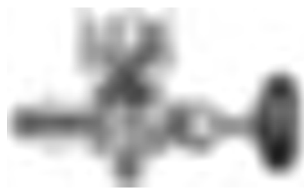
The labor prices on the car work for a 10-hour day are given below. Owing to the scarcity of labor, great trouble was had in keeping the proper size gangs to work the car outfit at the best efficiency: Foreman at $3. aborers at $1.65 (their number varying, but averaging four shovelers per car), plow team at $7.50, one-horse at $3.50, three dump men at $1.65, and track man at $2. In the daily cost is included the cost of carpenters building trestle.

The daily records showed that the cost of the work with wheel scrapers was 26¼ cents per cubic yard for an average haul of 350 ft., against 24¼ cents with portable track and an average haul of 600 ft.

The cost of repair work on ten cars during nearly five months did not amount to over $1, and they were practically as good as new.

Other comparative data showing the difference between the cost of concrete work done with wheelbarrows and Koppel's portable track have been recently given by Mr. Wm. S. Fargo, consulting engineer, Jackson, Mich.

* An illustration of this work appeared on our February cover.



Jos. Dixon Crucible Company's Graphite Exhibit.

Dixon's originality has made a decided impression on the world since 1827, when Joseph Dixon originated graphite crucibles and stove polish. In the eighty intervening years, the reputation for originality in discovering new uses for graphite and in advertising its uses has been successfully maintained by the Joseph Dixon's steel booth measured but 21 x 21 ft., was the originality of building a portable steel exhibition booth for the Atlantic City convention. The steel booth illustrated was built by Post & McCord, steel contractors, New York City, who are building two-thirds of the steel skyscrapers in New York, and while Dixon's steel both measured but 21 x 21 ft., with a height of 14 ft., yet it showed in every part the same perfection of construction as marks Post & McCord's building of towering office buildings.

The purpose of this original exhibit of a structural steel building, with a corrugated iron roof, was to show the tenacity, elasticity and appearance on steel of the four colors of Dixon's Silica-Graphite Paint, with which it was painted. This product is extensively used for protection of railroad bridges, water towers, trolley poles, steel cars, roofs, cornices, buildings, fences, smoke-stacks and all metal and wood constructions. Within the steel booth was another of Dixon's original advertising ideas, the largest paint can in the world, measuring eight feet in height, six feet in diameter, twenty feet in circumference, with a handle three feet above the can, and an opening and exit in the can, six feet high, two and a half feet in width. The appearance of the can was very striking, with

Exhibition Booth at Atlantic City.

2,000 degrees, or to 700 degrees F. It will be noticed that the mass of gases does not enter into consideration at all.

This surprising deduction is being accurately verified by the aforementioned Division of the Survey, from which it is found, when keeping other conditions the same and when keeping the initial temperature of the gases constant, that the final temperature of the air remains the same, whatever the amount of air sent through the boiler per second. So far the upper limit has not been reached with tubes clean inside and out, although the rate of evaporation has already been pushed up to many times that obtained even in locomotive practice.

Perry's theory takes into consideration four fundamental features affecting heat absorption at any point of the heating surface:

First: Temperature difference between the gases outside any portion of the boiler tube and the water inside.

Second: The number of molecules per cubic inch in the gases outside the boiler tube.

Third: The specific heat of the gases at constant pressure.

Fourth: The velocity of the gases parallel to the heating surface.

Of the four above factors, only the first has usually been considered. It will be readily seen that if we increase the temperature of the gases we decrease the number of molecules beating against any square inch of tube heating surface and thus the second factor largely neutralizes the first, especially at high furnace temperatures.

The third factor can be taken as constant equal to .24.

The fourth factor is the new and surprising one. Mr. Perry considers that a high velocity of gases parallel to the heating surface scrubs off more or less of the dense film of gases adhering to the metal surface, which film of gases has already become cold by proximity to the metal. The higher the velocity of gases the more the scrubbing effect, and consequently the greater the amount of heat transmitted. This theory necessarily assumes that the ability of the metal to transmit heat is practically infinite, and when we consider that we ordinarily never put through a boiler tube more than 1-1000 of heat it could possibly carry, it will be realized that this assumption is warranted.

Mr. Perry's theory and the Survey's verification of it will result in placing the steam boiler on a fairly secure mathematical basis, the same as generators and motors are now on. Thus far the experiments check out the theory excellently. The theory and results will be embodied in a special bulletin to be published in two or three months to be followed by later bulletins as the work proceeds.

"Crown" Pneumatic Hammers, Bulletin No. 2010, Ingersoll-Rand Company, 11 Broadway, New York. 24 pages, 6 x 9 inches, profusely illustrated. The hammers are fully described, every detail of construction is shown and every operation described. The design of this hammer is new and the construction simple. It is claimed to strike a harder, quicker blow than any other, with 20 to 30 per cent. less air and with slight cost for repairs. Made in five sizes for chipping, calking, scaling, flue beading, etc., and in four sizes, long stroke, for driving rivets from the smallest up to 1⅜-inch diameter. The bulletin also gives an interesting exhibit of a displacement air meter by which the performances of these tools have been tested and verified.

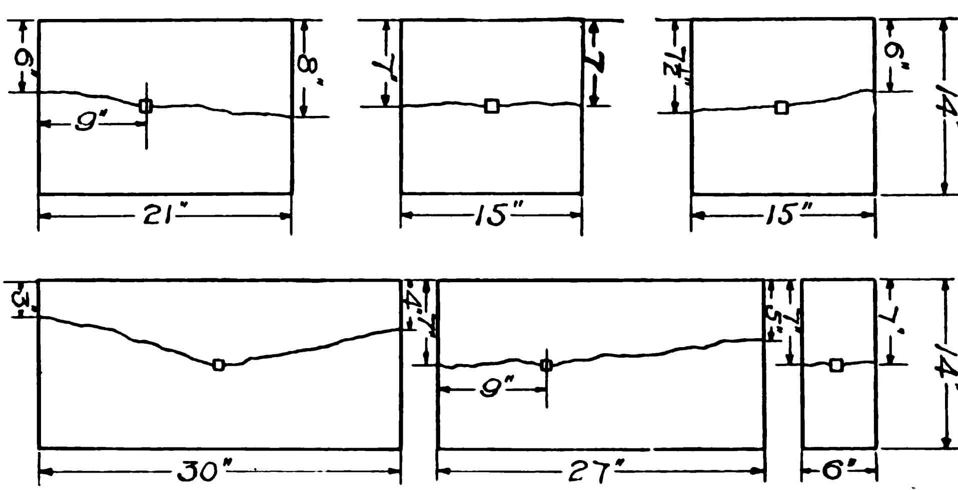
stick, in which were inserted knife edges twelve inches apart. The knife edges were placed directly over the supports and before any load was applied a zero reading was taken and then deflections were read every hundred pounds, and at failure. The descending plate of the machine bore down on top of the deflectometer and as the stone went down, the end of the indicating arm went up. The ratio of the arms of the deflectometer is as 1 : 10, and the deflection could be read to thousandths of an inch by means of a virnier. This apparatus was used at points which were covered by the top plate, but on points which were outside of the top, a weighted deflectometer was used.

The weighted deflectometer consisted of two oak sticks, which were fastened together rigidly and mounted on knife edges. The edges were planed on the stone as above, and the weight held the supporting arm of the indicator down on the stone. As the stone bent down, the indicating arm went down with it and registered the deflection on a scale fastened to the oak supporters. The ratio of the arms in this one is as 1 : 20. There were three samples of each kind of stone, and the load was applied at points which gave the ends the ratio of 1 : 1, 1 : 2, 1½ : 1, etc., to each other. Deflections were read under the load and at the two ends. There was a record made of the cracking and breaking loads, and the manner of breaking.

The stone broke in the same general way in each case, and in each case the crack passed under the load. The crane ran length-

SUMMARY.

	Dimension of Slab.	Load.	Deflection.	Deflection per 100 lbs. of load.
Load applied at center	6" x 12"	550	.033	.0060
Load applied at center	12" x 12"	1225	.042	.0034
Load applied at center	15" x 12"	1300	.038	.0029
Load applied at center	18" x 12"	1720	.035	.0020
Load applied 6" from end....	18" x 12"	1650	.037	.0022
Load applied at center	21" x 12"	1500	..039	.0026
Load applied at center	24" x 12"	1940	.049	.0025
Load applied 9" from end....	24" x 12"	1880	.0:6	.0024
Load applied 6" from end ...	24" x 12"	1400	.047	.0033
Load applied at center	27" x 12"	1700	.038	.0022
Load applied at center	30" x 12"	2150	.046	.0021
Load applied 12" from end.	30" x 12"	2150	.050	.0023
Load applied at center	36" x 12"	2120	.051	.0024



in the event of its success, will probably be followed by the building of added sections. Cast iron mooring posts with 2-in. metal have been located every 45 ft. and the surface of the dock is 7 ft. 8 in. above the ordinary water level. Such a dock presents features of low cost, largely due to its design, strength and durability and there is every reason for looking to a larger use of reinforced concrete for similar purposes in the future.—*Marine Review.*

The total length of submarine cables in the world is about 450,000 kiloms—*279,622* miles, of which 60 per cent. are British, 10 per cent. American, a little more than 9 per cent. French and about 7 per cent. German.

Sewer system, new water system, fire alarm boxes, electric railways, telephones, new and increased electric light plant, bridges, most extensive harbor improvements and no port dues—all this going on at one time in Manila, means that the city is becoming the American Hong Kong.

A cement that will resist white heat may be made of pulverized fire clay, 4 parts; plumbago, 1 part; iron fillings or borings free from oxide, 2 parts; peroxide of manganese, 1 part; borax, ½ part, and sea salt, ½ part. Mix these to a thick paste and use immediately. Heat up gradually when first using.

The cost of cleaning paved streets, in Rochester, N. Y., is given as follows, in a recent report of the city engineer, Mr. E. A. Fisher: Asphalt streets were cleaned an average of 103 times during the season at an average cost of $35.94 per 1,000 sq. yd.; brick streets required cleaning an average of 31 times at an average cost of $19.15 per 1,000 sq. yd.; Medina block stone streets were cleaned an average of 117 times at an average cost of $63.07 per 1,000 sq. yd.; common Medina stone streets were cleaned an average of 35 times at an average cost of $29 per 1,000 sq. yd.; macadam streets were cleaned an average of 13 times at a cost of about $15.40 per 1,000 sq. yd. All the work was done by day labor. The additional cost of sprinkling, which was done under contract, averaged 1.80 cents per square yard for the season, figured on a basis of 27 ft. as the average width of street sprinkled.—*Eng. Record.*

View of West Abutment taken from east side of river. The swing bridge seen has been abandoned.

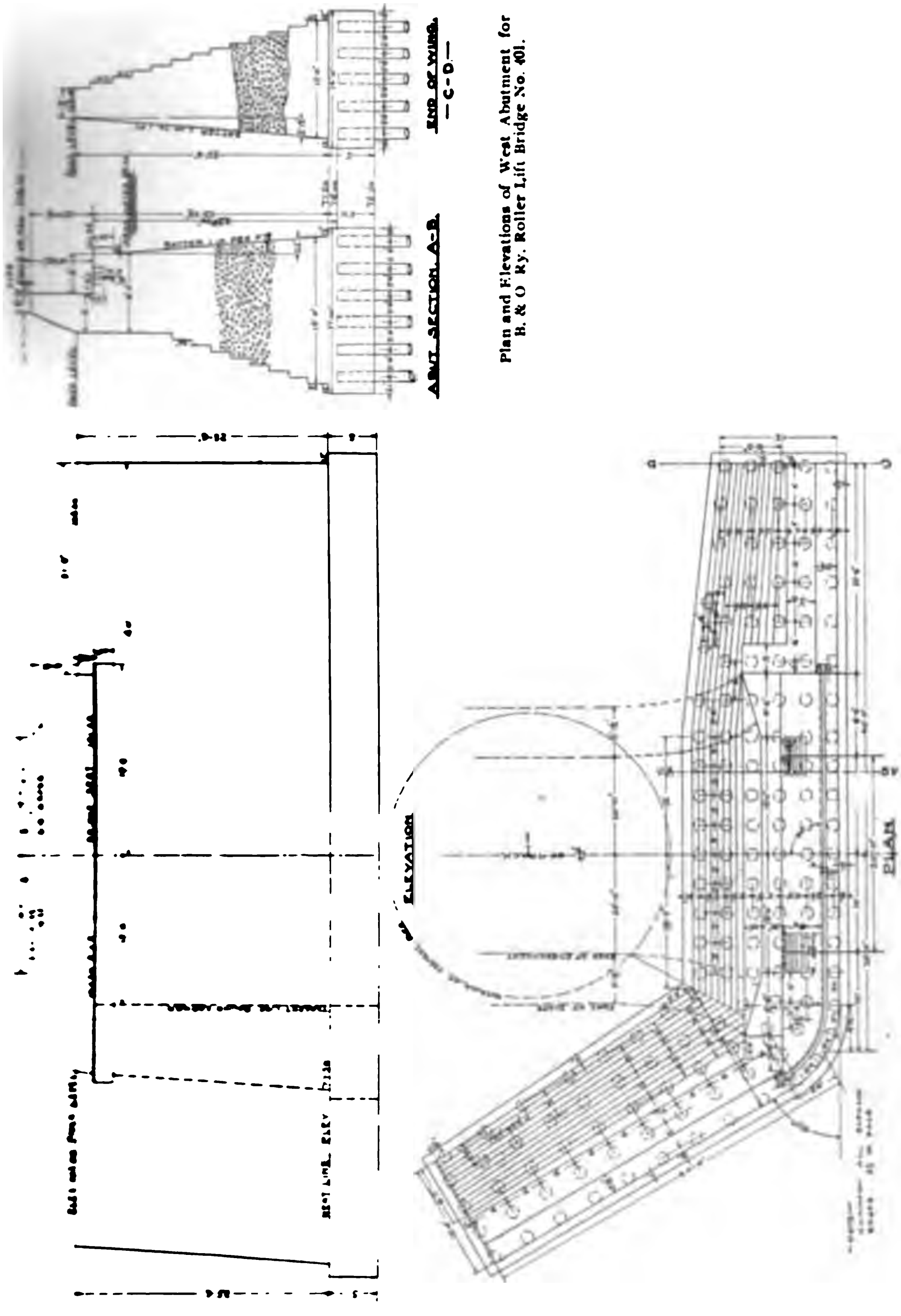
Bridge Work Near Cleveland.

By J. D. Mooney.

THE Baltimore & Ohio Railroad Co. has just completed the west abutment for its roller lift bridge, No. 401, which spans the Cuyahoga River at Cleveland. The bridge is the biggest thing of its kind in the world. It has a span of 230 feet, is single tracked and weighs 800 tons. The counterweights weigh 700 tons. The bridge will rise 282 feet above water when it is elevated. It was designed by the King Bridge Co. and erected by the Pittsburg Construction Co. It is now ready for use.

The contract for the abutments was filled by C. H. Fath & Son of Cleveland. Mr. E. C. Cooke superintended the work for them. H.

Concrete Mixing Plant in operation at the B. & O. lift bridge abutment.



Plan and Elevations of West Abutment for B. & O. Ry. Roller Lift Bridge No. 401.

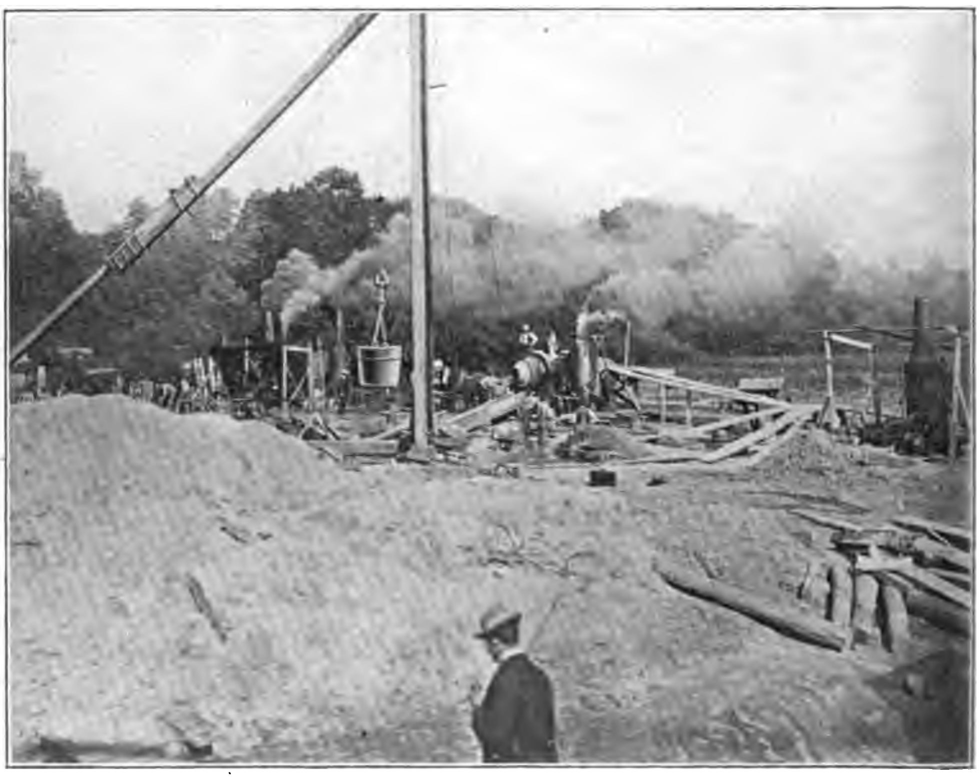
Rocker in position for Nickel Plate Roller Lift Bridge.

East Abutment of Bridge across Cuyahoga River, Cleveland Short Line R. R.

L. Dunham was resident engineer for the B. & O.

In making the west abutment, which is illustrated here, Freistedt interlocking sheathing was used for the coffer dams. This sheathing consists simply of a series of channels held together with Z-bars. Mr. Dunham proffered the information that the use of it had been very satisfactory and what few leaks had occurred in the sides were very easily stopped up with a little horse manure.

About thirty men were employed on the job. The concrete mixers had a capacity of eighteen feet and a maximum of 130 yards



Concrete Mixing Plant for footings of steel viaduct across Cuyahoga River. Cleveland Short Line Ry.

Rocker in position for Nickel Plate Roller Lift Bridge with bracing.

The structure will be made of steel with masonry piers and steel towers. There will be 9,000,000 pounds of steel in these towers. The girders will weigh 4,500,000 pounds; 5,000 cu. ft. of masonry will be used on the piers and footings; 30,000 lineal feet of piling will be used.

The bridge will be wide enough for two tracks. The construction of this bridge makes possible a low grade on the road. The cost is estimated at $1,000,000.

The Nickel Plate Railroad's new roller lift bridge over the Cuyahoga River at Cleveland is now being rapidly built, and it is expected to have it completed by September 15th. Trains will not be interrupted an hour during the course of construction, as they will pass over the old bridge and through the first panel of the new one, in which panel the floor beams will be left out. The lift bridge will be built at an angle from the horizontal, and when it is completed the old bridge will be cut away and lowered. The lift bridge will then be lowered into place and the floor beams and rails placed in the panels, through which the trains will have been passing. This will all be done between trains.

The bridge has a span of 160 feet plus 38 feet on the rollers.

It will be double tracked. A 50-H. P. motor will be used to lift the new bridge. The power will be gotten from the lines of the Cleveland Illuminating Co. The King Bridge Co. designed the work and the Pittsburg Construction Co. is putting it up. Mr. J. S. Yates is superintendent in charge for the latter firm.

The Largest Wagon.

What is believed in the Northwest to be the largest wagon in the world has been shipped by the Pioneer Mining Company, of Seattle, to Nome, Alaska, where it will be put into service carrying freight into the interior over the tundra distrist. To make the wagon most suitable for this springy ground, it has been fitted with 18-inch tires. The hubs of the wheels are two feet in diameter and the wheels are ten feet in diameter. The body of the wagon is 26 feet long and more than 7 feet high. The wagon was built in Alameda, California, at a cost of $700.

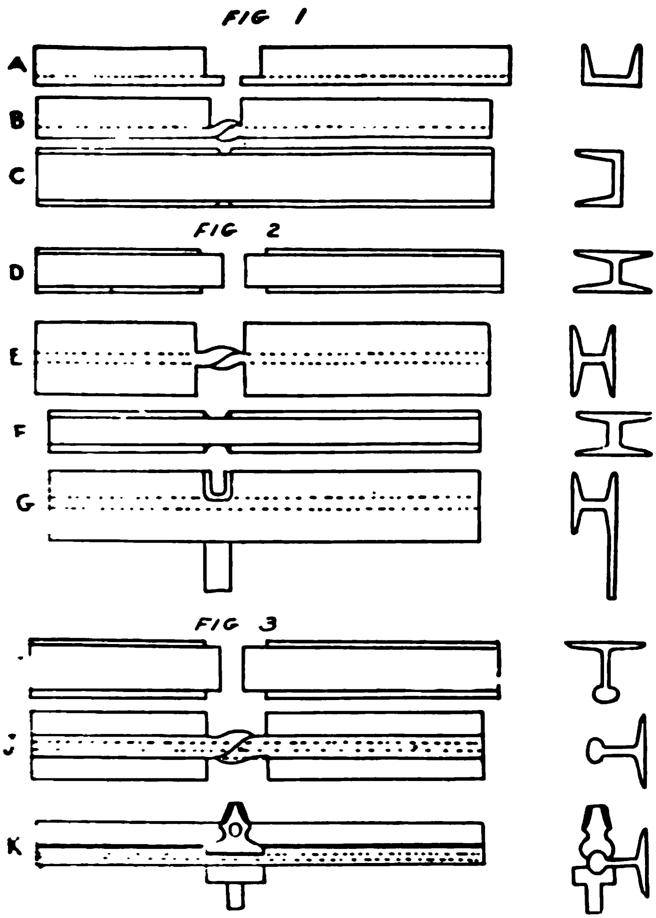
Scarfing and Welding Channels and I-Bars.

ONLY on rare occasions are blacksmiths required to weld Z-bars, or eye beams, but very frequently are they called upon to weld together short bars of channel, bulb-edge T and I bars. It is my intention in this article to lay down a rule that will apply to any of the irregular shapes used in structural iron work, says Mr. C. H. Richardson in *The American Blacksmith,* and one of the great difficulties met with when welding bars of this type is to prevent the flanges from heating before the point to be welded is effected by the fire.

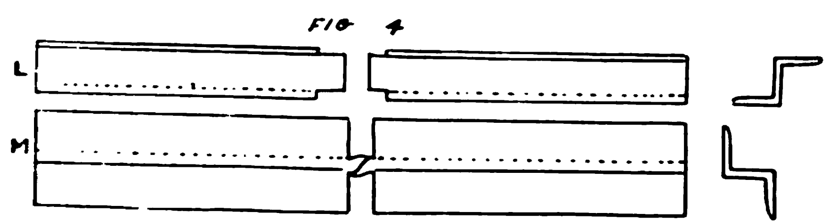
The plan I wish to formulate is, at all times weld all of these different styles as if they were ordinary bar stock. That is, cut the flanges away so there will be only enough of the bar projecting to allow for a good lap and weld. If care is taken the flange will be quite close together after the weld is made. This is so when they are scarfed for welding and two edges will meet as shown at C. Fig. 1. The filling-in-piece should be good iron, the thickness of the flange, and the width of the lap. This stock should not be scarfed. The reason for not doing so is because, when the separate heats are taken, the iron being so much softer than the steel the former works into the latter, leaving a good solid job with no thin scarfs to weld later on. Fig. 1 illustrates the different steps for scarfing and welding the channel bar. The I bar in Fig. 2 progresses in the same manner as the channel, varying slightly while the flanges are being welded on, as shown at G. Instead of welding the filling-in-piece all the distance across the flange, it has been proven that the

best plan is to let the stock run only to the centre or the web of the bar. Finish one side at a time, as shown. The filling-in-piece is now in place and is ready to be cut off flush and dressed up to size. The different steps to be taken for bulb-edge T-bars are shown in Fig. 3. It is, I think, thoroughly understood that the bulb-edge is cut away as well as the flange in this case.

Last, but not least, comes the Z-bar. The scarfing and welding of this is worked out in the same manner as the foregoing styles.



THE SEVERAL STEPS IN SCARFING AND WELDING CHANNELS AND T-BARS



Elevators.—V.

BY L. E. VATOR.

Description of Electric Drum Type Elevators.

THE following aims to be a general description of direct connected electric elevators of the drum type. There are hundreds of these in service at the present time, and they are not yet consigned to the scrap heap although it was said a few years ago that electric drum machines would soon be a thing of the past. Electric elevators are now in general use for both passenger and freight service, and thousands of persons travel on elevators every day; but of the many carried few know, and many more give the matter no thought, of the precautions taken in the designing, the building, and in the installing of an elevator in order that there will be no break-downs, accidents or any trouble which will cause excitement among the passengers, or put the machine out of commission for any length of time.

In a large office building it is of the utmost importance that the machines keep in good running condition with the smallest amount of care, and that the repairs be kept at a minimum both in cost and time consumed in making a repair. Because of this all parts of an electric elevator engine are made with an ample factor of safety, and as now made an electric elevator is not likely to be shut down for any length of time, in a space of four or five years, unless the armature of the motor burns out. Small parts, likely to wear, are found on the electrical apparatus, and can be carried in stock. The parts are made on the interchangeable system and are so designed that worn out parts can easily be renewed by the engineer. While a double worm geared machine may have gears that will last a lifetime, the single worm geared elevator engines may not last over four or five years. The time consumed in putting in a new gear and worm will amount to about twenty-four hours, at the longest, after the material is delivered at the building. With single worm geared machines trouble is apt to occur with the thrust bearing but this is usually remedied without any shut down.

The elevator engine may be mechanically or electrically controlled, and it consists of the following principal parts; the motor, the worm and gear, the drum, and possibly the control might be included. The machine can be arranged so that it will give one, two or variable speeds, this depending on the controller. It may be equipped so that a passenger machine may be used for lifting safes or other heavy objects, which are to be moved in or out of a building, in which case the elevator engine is spoken of as being "back-geared."

Finally it may be stated that there are two types or styles of drum machines, one with a single worm gear, the other with double worm gears, and for heavy freight duties a third style appears which is a combination of one of the other two with spur gearing which is in mesh permanently and which may be spoken of as the "duplex" type.

As a usual thing elevator engines of one manufacturer vary from those of another only in the minor details, and in order to understand electric elevators a minute explanation of the details of all the various elevator engines is unnecessary.

The drum is of cast iron, and usually scored so that as the one set of ropes wind off the other set winds into the same grooves. This enables a shorter drum to be used than would be needed if the counterweight and hoisting ropes each run in a separate set of grooves. The drum is on the same shaft as the gear to which it may be made fast in various ways. In Fig. 15 the gear shaft is a steel forging with two flanges on it. To one flange the gear spider is fastened by six pins, which are a force fit in both flange and gear. The gear

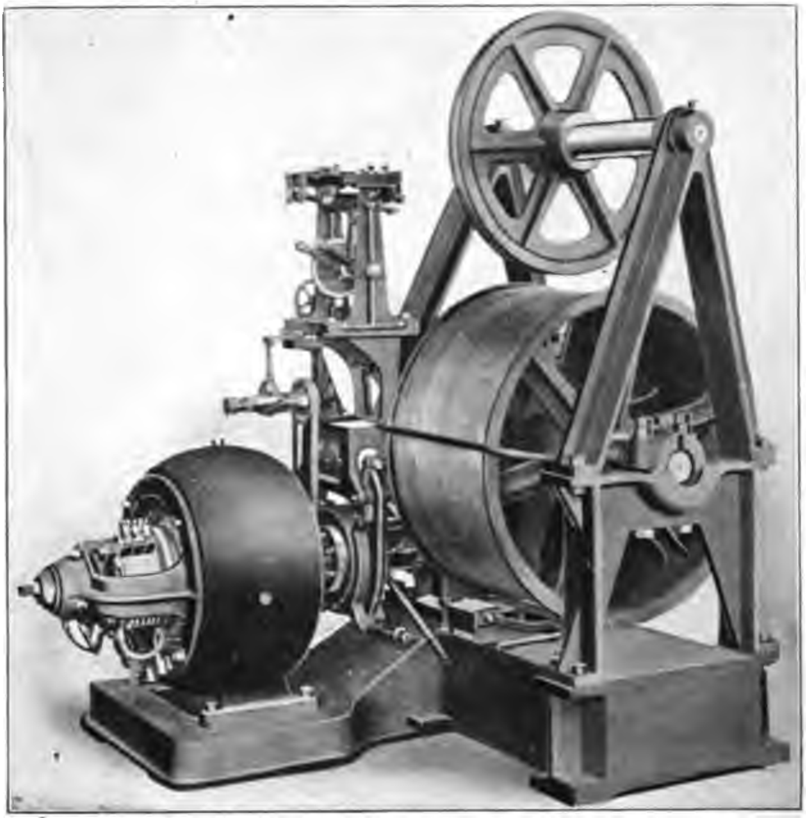


Fig. 13—A single geared elevator engine made by the Marine Engine & Mach. Co., that is a great favorite for medium high speed passenger elevators.

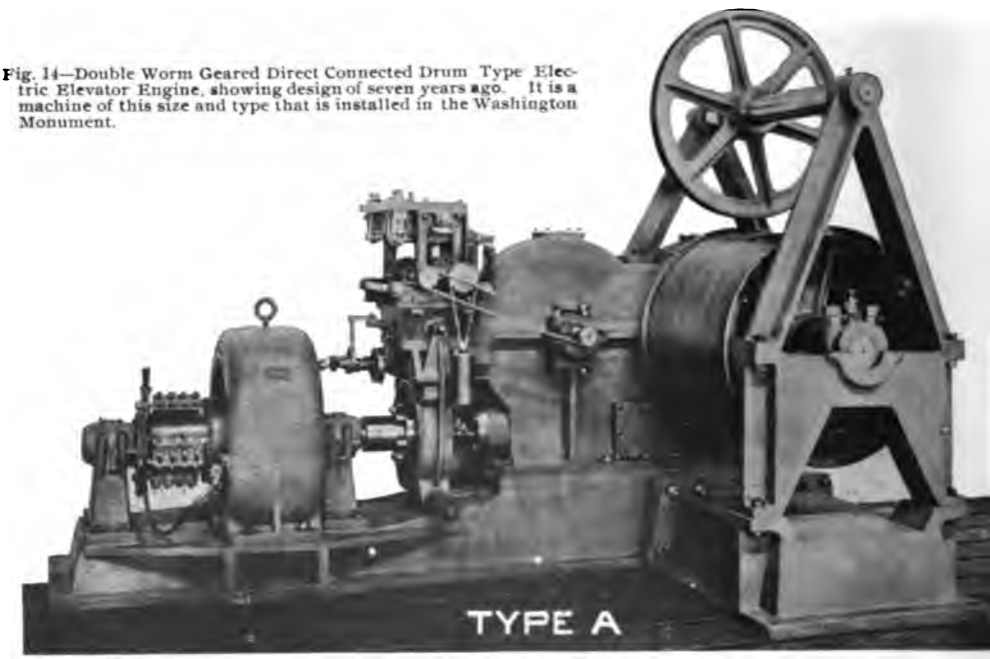


Fig. 14—Double Worm Geared Direct Connected Drum Type Electric Elevator Engine, showing design of seven years ago. It is a machine of this size and type that is installed in the Washington Monument.

too much. The oil bath, of which there is sufficient to cover the worm, is a combination of cylinder and castor oil. It should be changed every two or three months with new machines, and at longer periods after the gears "find themselves," so that all dirt and grit which may have gathered will be removed.

Motors, if direct current, are usually compound wound so as to be able to start easily at full load. After the car reaches its running speed the series field is cut out and the motor runs as a shunt machine. For high speeds a resistance is usually cut into the circuit in series with the shunt field thus weakening it, and causing the motor to increase its speed. Some elevator manufacturers buy the motor from the electrical manufacturing companies, while others prefer to make motors of their own design.

In order that the car may be stopped quickly and just at a predetermined point it is necessary to have a brake, and the brake pulley is usually also used for the coupling by which the worm and motor shaft are fastened together. This brake is usually set or clamped by means of a weight or spring, and is released either electrically by means of a magnet, or mechanically by a cam on the shipper shaft. Some makers use a band brake faced with leather. This is apt to run hot, char, and become brittle. Other makers use a block or clam-shell brake which consists of two iron clamps holding the brake shoes. Fig. 15 shows one of this type which is released by a magnet and clamped by a spring. By this arrangement any failure in the current supply will cause the brake to grip and hold the car. The brake shoe may be of whitewood only, or it

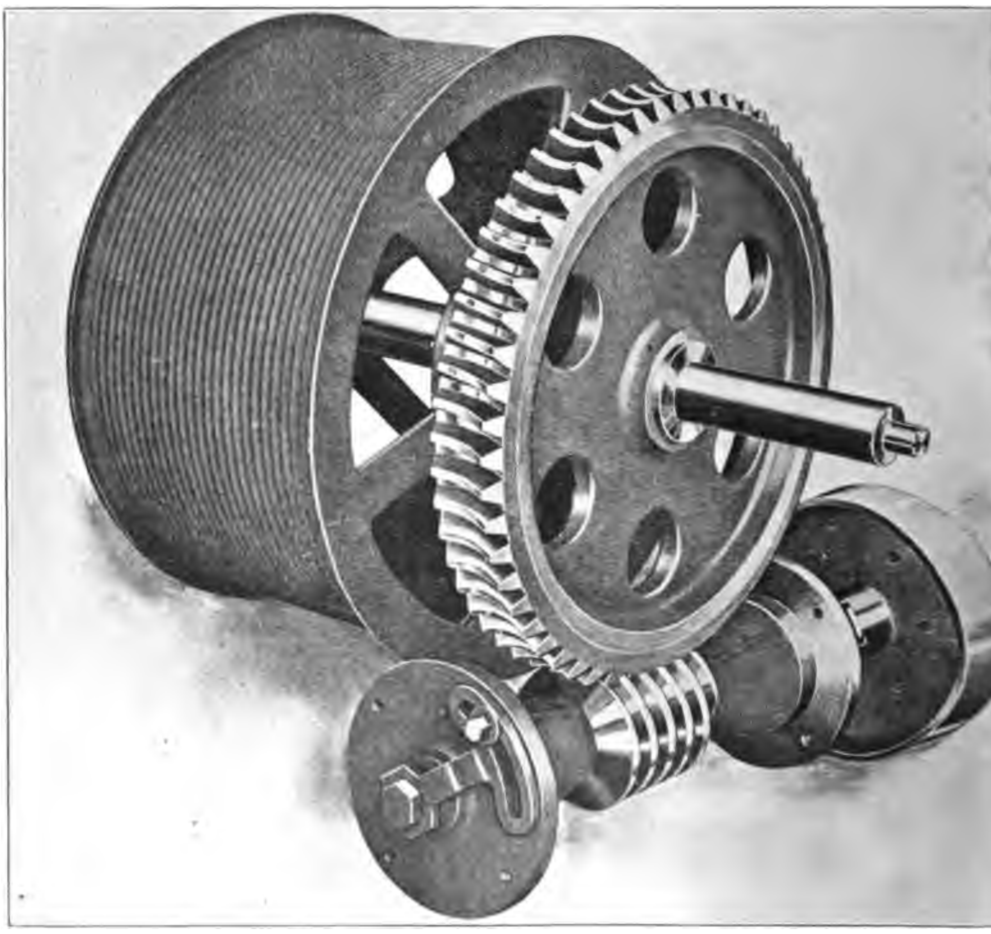


Fig. 17—Drum is bolted direct to the gear spider, and the gear is shrunk onto its spider.

device that will stop it without placing any dependence upon the operator. The device for accomplishing this is called the stop-motion switch or limit. It may be, and usually is attached to the elevator engine; but sometimes in addition to this, there are switches in the hoistway actuated by cams on the car. These cutouts are called hoisting limit switches, and may act as a precaution in case of failure of the engine limit, or they may slow-down the car to the slow speed before the final point of travel is reached. The limit on the engine may be driven by a sprocket chain as in Fig. 14 and 27; or the drum shaft may be extended out and a screw turned on it for a traveling nut to run, or the screw may be driven by a gear on the shaft as illustrated in Fig. 23 and 22. In Fig. 15 is shown a limit, chain driven, which shows the arrangement of the screw and traveling nut very plainly. When the traveling

Fig. 19.

Fig. 28—High speed Electric Elevator Engine, passenger service made by the A. B. See Mfg. Co., Jersey City, N. J.

nut, which is also a gear, reaches the clamp nuts, one being set for either end of the travel, the dogs engage and the standing gear, in back of the traveling gear, is revolved. On the same shaft with this last mentioned standing gear are several cams, and by means of these working several levers the current is opened and the engine brought to a stand still. In Fig. 22 the screw travels, and when the limit operates the brake is also set. The limit shown on the elevator engine in Fig. 28 is for an automatic passenger machine, and can stop the car at every floor as well as at the top and bottom. No traveling screw is used here; but the ratio of the revolutions of the limit shaft and of the drum shaft is made very large. The arms revolve and knock the contacts out and in as the arm passes by the cam. The ratio of the revolutions must be large as the shaft must only revolve about seven-eighths of a turn for a maximum. The limit on the engine in Fig. 27 is on the same principle.

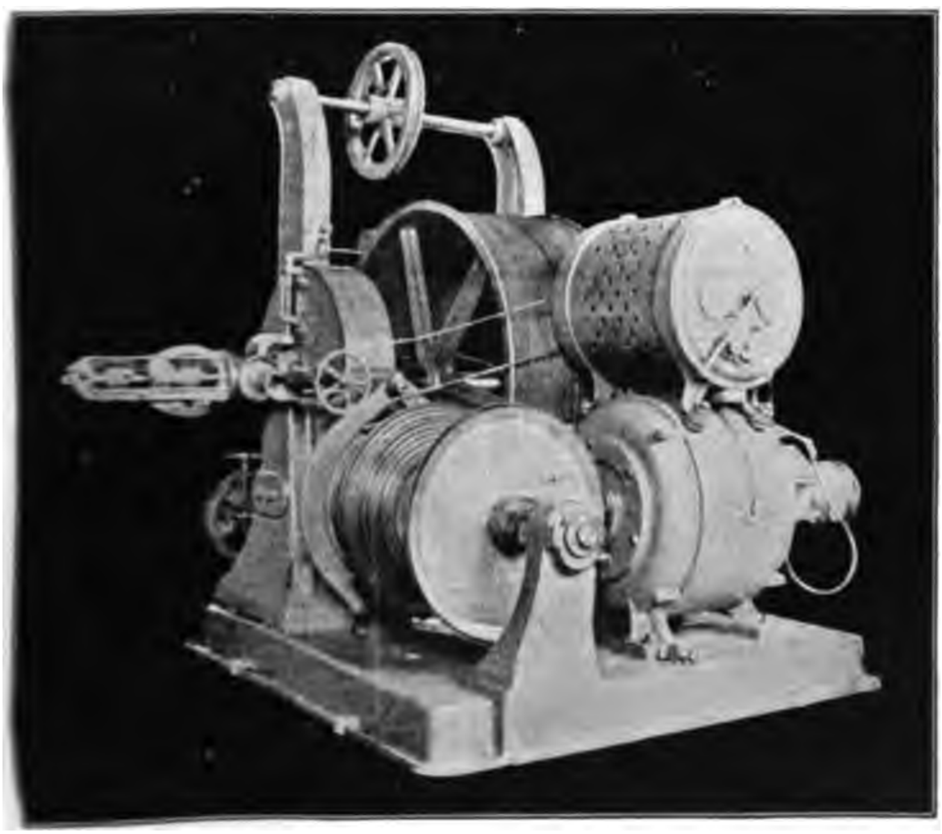


Fig. 27—Electric Elevator with friction gearing.

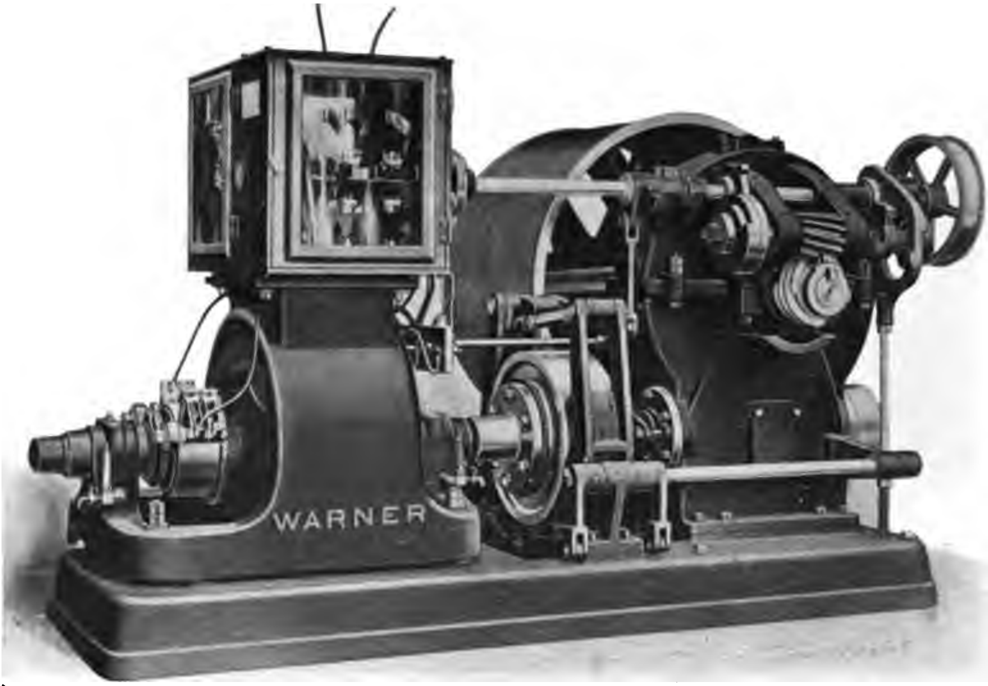


Fig. 22—Heavy Freight Elevator Engine, manufactured by Warner Elev. Mfg. Co. This is operated by a shipper sheave shown at extreme right, which is keyed to the shaft that operates the controller.

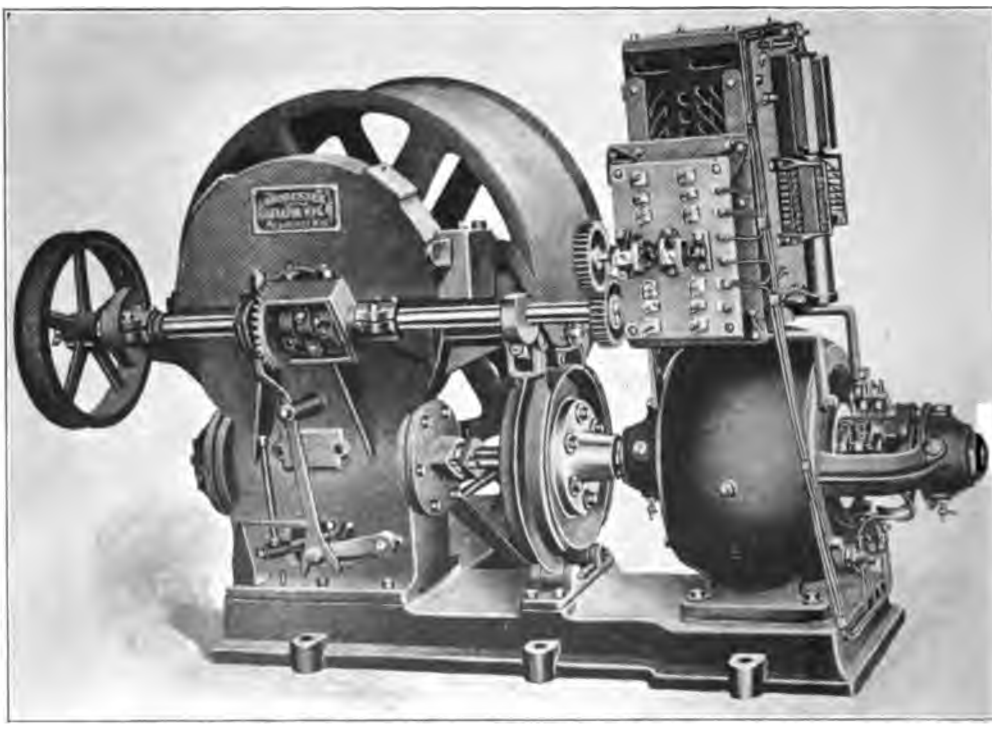


Fig. 23—An elevator engine for freight work that is mechanically controlled but electrically accelerates. By revolving the shipper sheave shown at the extreme left, the main switch is closed. The solenoid on the controller then pulls the contact plugger up, which gradually cuts out the motor starting resistance. The limit, braking mechanism and slack cable device are plainly shown.

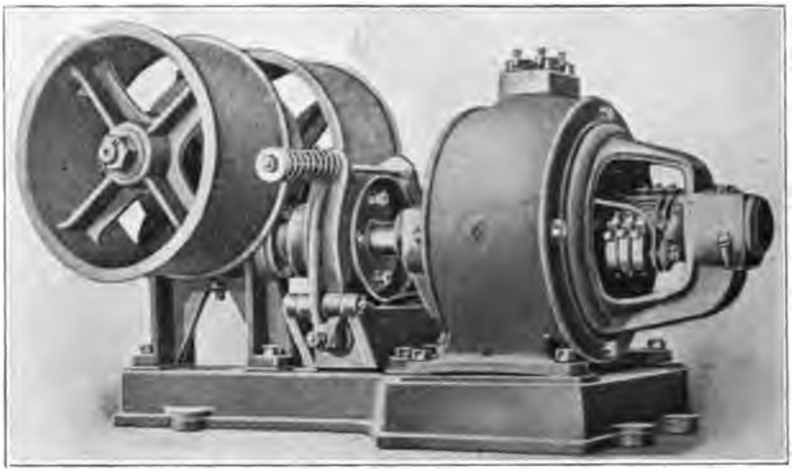


Fig. 25—Electric Dumb Waiter Engine. This shows up the brake nicely, but the limit and controller are not shown.

and the up and down motions are gotten by throwing either one or the other large iron bevel friction gear into mesh with a smaller gear mounted on the motor shaft. This elevator came out about ten years ago; but did not meet with the expected success.

In Fig. 22 a heavy duty Warner, of Cincinnati, elevator engine for freight service is illustrated. This shows up the control, limit, and brake features to good advantage. In this limit the screw shaft travels longitudinally so that, when the limits of travel are reached the electric circuits are opened and the brake applied. The cam opening the control circuit has a longitudinal travel, so that as the dog rides up on the cam, and reaches the maximum point of throw, a further revolution of one-half turn or more, which would only happen after the brake shoes were badly worn, would not close the switches again.

The Brodesser elevator engine in Fig. 23 is also for freight service. It has a semi-mechanical control, the reversing switch being

Fig. 26—Elektron Electric Dumb Waiter Engine.

closed by means of the shipper sheave and rope. The solenoid on the control then lifts the contact plunger, cutting out the various steps of resistance, and allowing the motor to get up to speed.

For exceedingly heavy duties such as 25,000 to 70,000 pounds at speeds of from 50 to 75 feet per minute the elevator engines are frequently back geared, that is instead of putting a drum on the gear shaft a small spur gear is placed there. This gear meshes with a larger gear which is either directly connected to the drum by bolts or is keyed to the drum shaft. The engine when thus arranged is called a "duplex elevator engine." Such an engine made by the Brodesser Elev. Mfg. Co. is illustrated in Fig. 24. It will be noticed that this engine is operated by an alternating current motor.

Electric dumbwaiters are rather high priced; but their convenience and fairly low cost of maintenance makes them a necessity in large or high buildings where there is much handling of small articles. The control is so arranged that any person with intelligence enough enough to push a button, on which is a figure or letter corresponding to the station it is wished to stop the car, can operate the engine. Fig. 25 is a double drum engine made by the Marine Engine and Machine Co.; but for ordinary service a single drum is usually used. The Elektron dumbwaiter engine is shown in Fig. 26.

An elevator engine manufactured by the Otis Elevator Co., Yonkers, N. Y., is illustrated in Fig. 27. This machine is very



Fig. 28—Marine Engines & Mach. Co.'s medium size automatic passenger elevator engines.

Comparative Cost of Fireproof Residence Construction.

JOHN PHELPS SLACK.

THE prospective homebuilder in his consideration of the various types of construction and materials available must ultimately base his decision on the bed rock of economy—namely, the most to be obtained in durability, beauty and comfort, from a given expenditure. In choice of plans for the proposed structure individual taste in choice of design in both exterior and interior arrangement may enter to an almost unlimited extent without serious impairment of the finished structure. Before this point is reached, however, comes the question of fireproof vs. old style construction. Here the builder is confronted by the necessity for a radical decision. Since fireproofing methods effectively and economically applied to residence construction are a rather recent development in the progress of the building industry the ignorance of methods and comparative costs which generally obtains on the part of the laity should not be occasion for wonder. Therefore, in this connection, a word of comparison be-

cessfully solved by either of the methods described in the preceding articles, due to the fact that the buildings will be too extended, or the air ways too long, or it may be that sufficient volume of fresh air cannot be obtained by natural methods, or else that the supply air cannot be heated to the desired degree of temperature.

Let us take the case of an up to date high school, which will have the usual layout of recitation rooms, halls, corridors, teachers' rooms, committee rooms, assembly hall and toilet rooms, with perhaps manual training rooms in the basement and laboratories on several of the upper floors. It is at once evident that no natural means of fresh air supply could properly accommodate such a variety of rooms either in proper volume or in degree of heat necessary to warm the rooms in cold weather. Such a case can only be treated by using a mechanical ventilation, or, rather, a mechanical circulation of air to the various rooms, this circulation being forced by one of the several types of fans or blowers in use today, the proper type depending entirely on the individual case.

In the case of such a building as has been mentioned above it is almost always desired to keep the building warm when the fans are shut down and for this purpose a direct system of radiation is also installed—the system being so proportioned that it is capable of producing, unaided, a temperature of 70 degrees Fahr. in all the rooms except possibly the assembly hall. The advantage of this is that the building doesn't cool down at night and is, therefore, always ready for occupancy, the fans being started just before school commences and shut down at the close of the last session.

The direct system is usually a steam system, the two pipe being preferred as it is apt to be quieter, the same boilers that supply steam to the indirect heaters supplying steam to the direct system, though the piping had better be entirely separate.

The indirect system is the means of furnishing the fresh air to the building. If the direct system is so designed that it is capable of heating the building unaided the indirect system will be so proportioned that the entering air will be at the temperature of the rooms, which is about 70 degrees. If, however, the direct system is not able to furnish all the heat necessary, as may be the case, then the indirect heaters must be so designed that the fresh air may be raised in temperature to some higher point as 90 degrees perhaps, a temperature which shall be high enough to bring to the various rooms the required extra amount of heat to keep them at the proper temperature in the coldest weather. In any event the amount of air supplied is governed more by the demands of purity than of heat to be carried so that the latter end is reached by raising the temperature rather than increasing the volume supplied.

The fans are generally arranged so that they are centrally located. If this can be done, as, by this arrangement, a more even distribution of air to the various portions of the building may be obtained. The fans, filters or air washers, heaters or tempering coils, are usually located together in some room into which air can be easily drawn from the outside, the common arrangements being illustrated in Figs. 1 and 2.

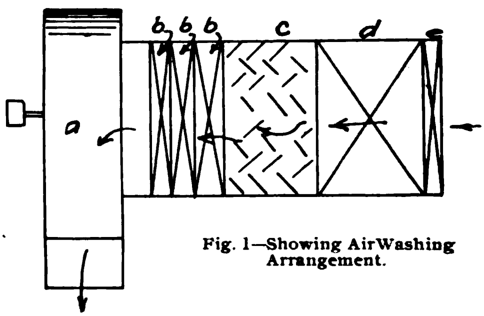


Fig. 1—Showing AirWashing Arrangement.

a = Blower or fan.

b = Heater sections.

c = Chamber with baffles to catch moisture from air.

d = Air washidg or spray chamber.

e = Tempering coil to raise air to temperature above freezing.

There are several well known types of fans each of which is best adapted to its own especial line of work. These classes may be defined as the propeller type the disk fan and the steel plate fan or blower type. The two former are fans that work to the best advantage where they do not discharge against any pressure. They are, therefore, well adapted to work as exhaust fans where the discharge is into the open. For work where pressure is needed to force the air to the various parts of the building, for instance, the blower type is the fan that is needed. This type is generally used for this purpose and will be found to work well when delivering against a pressure corresponding to a half inch of water column. If, however, the run is small and the resistance very slight a

keep the air reasonably pure in those rooms. A positive exhaust should be used in these cases. This may be obtained by the use of a heater in the vent flue from the laboratory. This is often done in the flue from the hoods in the chemical laboratory, and for the smaller hoods a burning gas jet will be found to be sufficient.

Laboratory ventilation is so designed that the flow of air shall be from the corridors to the laboratory rather than the reverse as this arrangement insures the passage of all fumes, etc., to the vent and insures a pure air in the corridors at all times.

Committee rooms, if large enough to need an indirect ventilation, are treated like the recitation rooms.

Teachers' rooms and halls, meaning corridors, are not usually provided with indirect systems.

Toilets are provided with a positive exhaust so arranged that the flow of air is from the corridors into the toilets. From 20 to 30 cubic feet of air per minute are allowed to pass through each fixture by means of the local ventilation system, thus keeping the air in the toilet rooms sweet and pure.

Each supply duct and vent duct should be provided with dampers at such points that the whole system can be "tuned up," thus giving each room its required amount of fresh air. These dampers will allow any room or series of rooms to be cut out at any time if it is so desired, as is often the case in evening entertainments; for instance, when the assembly hall and two teachers' rooms will be all that are needed. It would be very wasteful of energy to run the whole system for the accommodation of these few rooms.

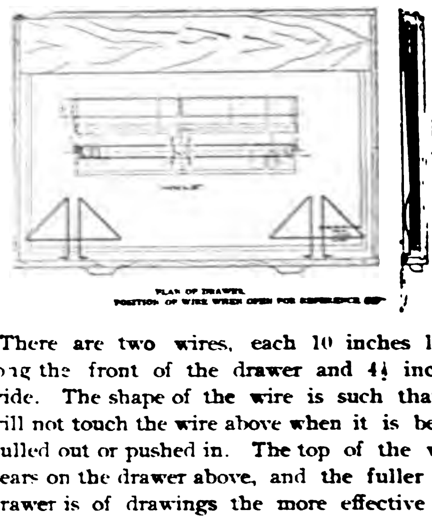
The regulation of the temperature, both of the air within the rooms and the incoming air, is automatic usually. Thermostats are provided with the direct system and will automatically control the radiators for all kinds of weather.

The temperature of the supply air can be regulated by the mixing dampers located between the fan and the heating or tempering coils in the basement and may be automatic. By the use of this mixing damper the whole, any part or none of the air that is drawn in from out of doors can be passed through the coils, thus giving a wide range of temperature regulation to the supply air.

Where coils of some size are used it is customary to so arrange them that certain parts of the coil may be cut out, thus reducing the total heating surface available to the desired point. For instance, in getting the ordinary wrought iron pipe heaters instead of getting one with nine rows of pipes deep get three heaters, one two pipes, one three pipes and one four pipes deep. Then by connecting each section up separately combinations of two, three, four, five, six, seven and nine pipes deep may be obtained, which is a decided advantage.

Holding-Down Wires.

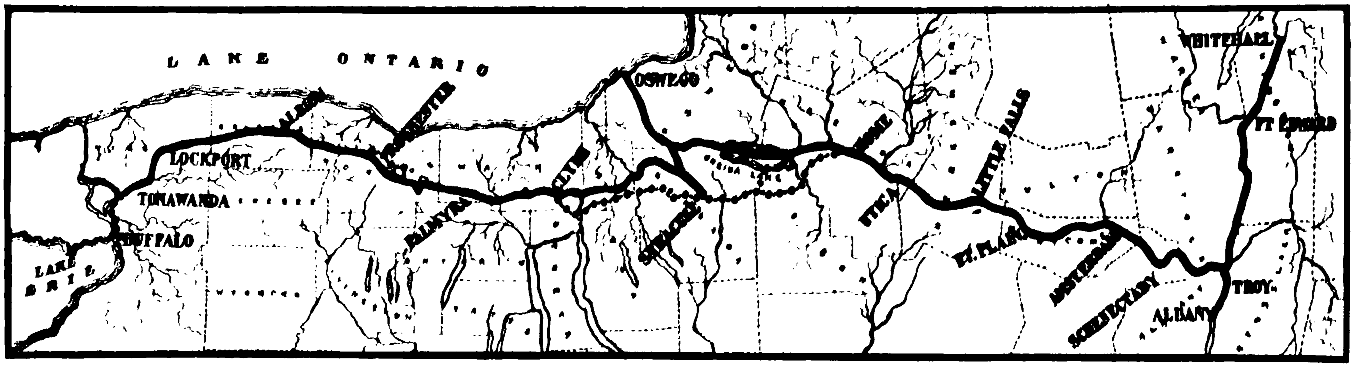
There are several devices for holding down drawings and papers in drawers when the drawer is left closed, and the one illustrated, made by the Economy Drawing Table Co., Toledo, Ohio, is a very unique device.



PLAN OF DRAWER.
POSITION OF WIRE WHEN OPEN FOR REFERENCE

There are two wires, each 10 inches long along the front of the drawer and 4½ inches wide. The shape of the wire is such that it will not touch the wire above when it is being pulled out or pushed in. The top of the wire bears on the drawer above, and the fuller the drawer is of drawings the more effective are the wires. Two wires are required for a drawer 20 inches wide or over, and can be easily attached to any drawer.

The matter of holding down drawings in drawers is something that distresses the average draftsman greatly, and can be accomplished in a great many ways by having a board on hinges in the front part of the drawer, or by having weights on strings, or by having a small piece of pipe or other material and laying it on the drawings when the drawer is ready to be shoved in place, the rear end of the drawer being covered by a thin board which will keep the drawings from curling up.



MAP OF THE ROUTE OF THE NEW YORK STATE BARGE CANAL

The heavy line indicates the route of the proposed canal also the branches to Lake Champlain and to Lake Ontario at Oswego. The dotted line indicates the diversion of the new from the old canal, from Clyde to Rome and a short distance near Rochester. That portion from Tonawanda to Buffalo is to follow the Niagara River which the federal government is dredging to suit larger boats. The peculiar offset in the general line of the canal north of Syracuse may have been straightened since the original map was made, for a part of route appears to be running southeast instead of southwest.

Hydraulic dredge "Oneida" in canal near Oneida lake, cutting toward Rome, N. Y. Cutting a new section of the canal in sandy soil. The banks of the spoil field were first made by a Lubecker trencher. A section of the spoil pipe line is shown in the distance ready to be coupled to when the dredge has advanced far enough. Each dredge has in its fleet a number of pontoons to support pipe, one or two tugs and launches, a floating machine shop, and sometimes a house boat for the housing of some of the crew.

created and plans adopted for the construction of about 445 miles of canal under this act. Surveys and estimates showed that a cost of nearly $101,000,000 will occur before the project is finally completed.

On December 15th, 1904, proposals were received by the Superintendent of Public Works for the first six contracts, Nos. 1 to 6 inclusive, as follows:

Contract No. 1. Excavation of 7.075 miles of river channel, Champlain canal, between Fort Edward and Northumberland.

Contract No. 2. Excavation of channel for 0.91 miles, Erie canal, and construction of locks through village of Waterford.

Contract No. 3. Excavation of channel for 2.164 miles, Champlain canal, near Fort Miller, locks, etc.

Contract No. 4. Excavation of 4.83 miles, Erie canal, near Oneida lake and incidental work.

Contract No. 5. Excavation of 5.66 miles, Erie canal, near Savannah and incidental work.

Contract No. 6. Excavation of 3.28 miles, Erie canal, near South Greece, and incidental work.

These six contracts were selected as the first to be awarded, owing to the fact that they represented substantially the various characters of material entering into the construction of the canal, and the prices bid for the above contracts would permit of reaching conclusions in regard to the accuracy of the first estimates.

The six contracts above enumerated cover a total distance of about twenty-four miles and were awarded for 11.6 per cent. less than the Engineers' estimate of cost for those same sections, and upon which estimate the appropriation of $101,000,000 made in 1903 was based.

Since December, 1904, and up to January 1, 1907, the following barge canal contracts have been awarded:

Contract No. 7. Bridge superstructures on Contracts Nos. 2, 3, 4, 5 and 6 at various points.

Contract No. 8. Dam and locks on the Mohawk river, Erie canal, near Rotterdam and Cranes Village.

Contract No. 10. Excavation of 1.2 miles, Oswego canal, in city of Fulton, construction of dams, locks, etc.

Contract No. 11. Excavation of 1.6 miles of channel, Erie canal, construction of locks, etc., near Waterford.

Contract No. 15. Excavation of 6.8 miles, Champlain canal, near Whitehall, construction of locks, dams, etc.

Lubecker trencher near Lake Oneida

Dredge "Oneida" at Sylvan Beach cutting through a bend of the Oneida river, near Oneida Lake. Mr. A F Wooley of the E E. Corp. is in charge of the work at this point. (Contract No. 4)

Contract No. 16. Bridges on Contracts Nos. 11, 25 and 27, various points.

Contract No. 17. Dam and lock on Mohawk river, Erie canal, near Amsterdam.

Contract No. 18. Excavation of 3.63 miles, Erie canal, and construction of lock, dam, etc., near Mindenville.

Contract No. 19. Excavation of 12.46 miles, Erie canal, and structures from Niagara river to Sulphur Spring.

Contract No. 25. Èxcavation of 13 miles, Champlain canal, construction of locks and other structures near Comstock.

Contract No. 27. Excavation of 3.76 miles, Champlain canal, construction of locks and other structures near Fort Edward.

Contract No. 34. Bridge over Erie canal at Waterford.

These twelve contracts covring a distance of about forty-four miles were awarded for 12.9 per cent. less than the Engineer's estimate of cost for the same work, being the estimate upon which the appropriation was based.

In addition to these eighteen contracts this Board at its meeting prior to March 18, 1907, considered and approved the plans and specifications for eight contracts, covering 142 miles and estimated to cost $15,353,954.

Contract No. 12. Excavation of 43.73 miles, Erie canal, from Brewerton to Mosquito Point bridge.

Contract No. 13. Excavation of 7.46 miles, Erie canal, including locks Nos. 22, 23 and 24 from Fort Bull to Contract No. 4.

Contract No. 14. Excavation of 14.3 miles, Erie canal, including Crescent dam and Viscer's Ferry dam and lock No. 7.

Contract No. 20. Excavation of 18.5 miles, Erie canal, dredging river channel from Rexford to dam No. 6 (Cranes Village dam).

Contract No. 26. Excavation of 0.769 miles, Champlain canal, dredging in Hudson river at Fort Edward, from north end of Contract No. 1 to south end of Contract No. 27.

Contract No. 28. Excavation of 35.2 miles, Erie canal, from Cranes Village to lock No. 16.

Contract No. 30. Excavation of 21.6 miles, Erie canal, from Rocky Rift to the lower end of lock No. 20.

Contract No. 35. Excavation of 0.85 miles, Oswego canal, including locks Nos. 7 and 8, the canal prism, and the raising of the curved dam in said city.

The total cost of the twenty-six contracts referred to, based upon the contract prices for awarded work and the estimated prices on

Although as heretofore stated, many contracts have been awarded, yet at this writing no lock masonry has been laid and if it is thought wise by the Canal Board, or by the Legislature, or both, it is not now too late to so construct them as to provide for a depth of fourteen feet of water over the miter sills of all locks.

It is believed by a majority of this Board that sufficient money will be saved in the construction of the canal to meet this additional cost without exceeding the original appropriation of $101,000,000. This statement is borne out by the facts stated in the message to the Legislature, namely:

"Under the contracts thus far let for about $20,000,000 worth of work, the estimated cost will be about $2,000,000 less than the estimates made at the time the Barge Canal Act was passed, despite the increase in the prices of labor and material, and despite also the fact that the work includes twenty-one locks which have been widened to forty-five feet instead of twenty-eight feet as originally contemplated."

A resolution having been unanimously adopted by the representatives of many municipal bodies and commercial associations at a public hearing given by this Board, recommending a change in location through the Montezuma marshes, and this Board after carefully examining the situation having adopted a resolution recommending to the State Engineer that the route south of Crusoe Island and known as the "South Route" be adopted, it has been proposed to amend the Barge Canal Law and provide for a route which from the junction of the Seneca river and Clyde river would follow the Clyde river and its tributaries to a point near Macedon.

The adoption of the "South Route" is of additional importance by reason of the possible construction of a canal from some point on the Barge Canal in or near Seneca river to Cayuga lake. The State Engineer was directed by chapter 699 of the Laws of 1905 to make a survey and estimate of cost for such canal which has been done, the estimated cost thereof being $2,677,000 for a canal of the same depth as the Barge Canal, namely, twelve feet.

In case the Legislature should hereafter provide for the construction of this connecting canal, its cost would be decreased by upwards of one and one-fourth millions of dollars should the "South Route" be adopted, as a considerable portion of the distance which would otherwise have to be covered by the connecting canal would be already covered by the construction of the Barge Canal.

Although the route now described in the Barge Canal Act and

know as the "Middle Route" is $5\frac{1}{8}$ miles shorter than the proposed "South Route," yet the latter can be built for $162,000 less than the former, to which saving would be added the estimated saving of about one and one-fourth millions of dollars in case the connecting canal should be built, and would give a channel width of 150 feet for the full distance from the point of divergence to the point of intersection, in lieu of a 75-foot channel width.

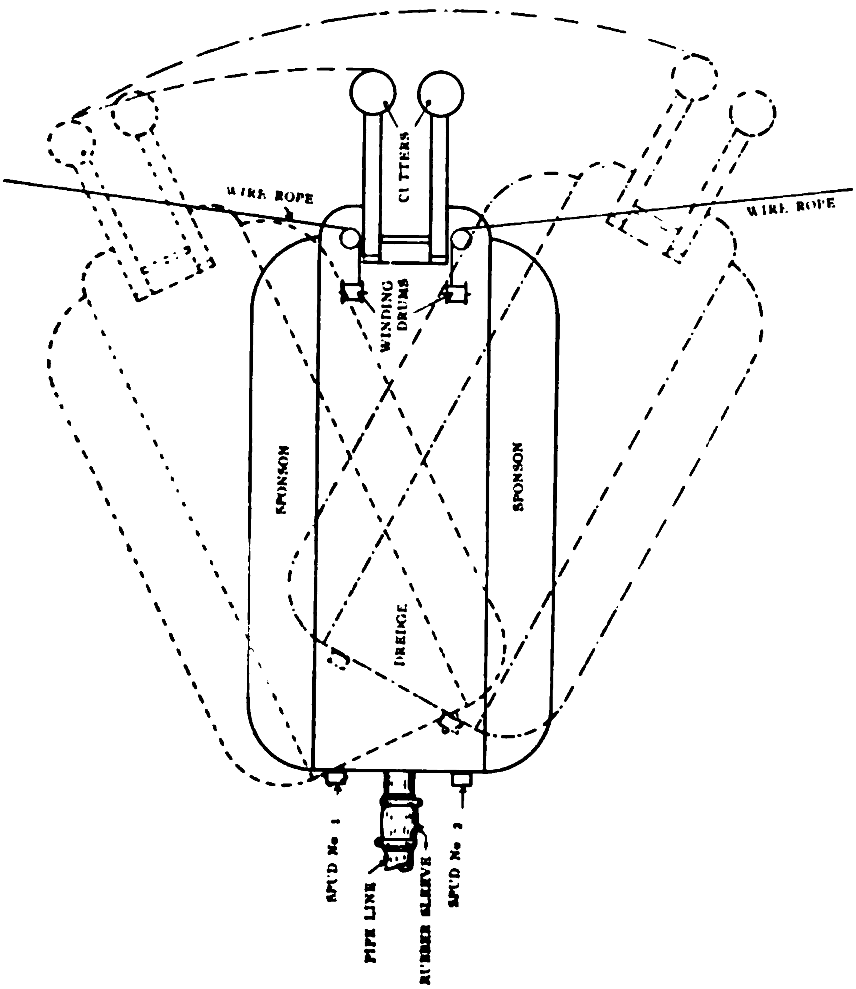


Diagram showing manner of operating the hydraulic dredges. The dredge is placed in center of the cut and Spud No 1 dropped into the soil of the bottom and by use of winding drums the dredge is swung to the left the width of the channel to be cut. Spud No 2 is the dropped and No 1 lifted and the dredge swung around toward the right, cutting its way as it proceeds. As will be seen, the swing to left and then to right advances the dredge.

By the "South Route" Savannah would be equally as well provided for as by the present old Erie canal system; Clyde and Lyons would have equal facilities with either route; while by the connection of the Cayuga and Seneca lakes and their tributaries with the canal, Cayuga, Ithaca, Geneva and Seneca canal section would be provided for.

The act adopting the "South Route" would also provide for lowering the Lockport and Tonawanda level about six feet, permitting the canal to be fed and entered direct from the Niagara river at Tonawanda, and would permit the abandonment of the present canal from Black Rock to Tonawanda and would be beneficial in draining large areas of land adjacent to the Tonawanda creek watershed. The clause in the present act which states: "The existing canal from Tonawanda creek to Main street Buffalo, shall be retained for feeder and harbor purposes," could be amended so that it would read as follows: "The Erie canal from Black Rock to Main street, Buffalo, shall be retained for harbor purposes." This would permit of the Niagara river between Tonawanda and Black Rock, a distance of about eight miles, being utilized for dock purposes in connection with the improved Niagara river. The United States government has undertaken the work of making a channel 200 feet in width and twenty-three feet in depth from Lake Erie through Black Rock harbor, connecting with the Niagara river by a large lock 650 feet in length and 70 feet wide and a depth of 24 feet on the sills and to be built at an estimate cost of $1,700,000.

This width of 200 feet will be maintained except at the curve around Fort Porter where it will be 240 feet wide.

It might be stated here that the present channel in Niagara river between Buffalo is so shallow that vessels having a draft of more than 14 feet cannot use it. Hence, boats in the Tonawanda lumber trade are of a smaller type than those which sail between lake ports exclusively. With the new lock it will be sufficient for the largest vessels now built or that will be built for some years to come. (Why build them any larger than The J. Pierpont Morgan, which is 600 feet long, and with 14,889 net tons drew 21 feet and 6 inches?).

The canal proper will end at this lock and from that point to Rattlesnake Island the Government will dredge the present channel to a depth of 23 feet and a width of 400 feet. Below Rattlesnake Island the river is now ample depth for the largest boat as far as Tonawanda. The first section extends from the foot of Maryland Street, Buffalo,

the wall that separates the canal from the harbor will be removed, the new channel taking both canal and harbor. The contract for the second section has been let to the Buffalo Dredging Company at its bid of $710,000 and work will probably be begun in August. This section, which extends down to the harbor a distance of about 4,000 feet from where it joins the first section, contains much more rock than is found farther up, and the work will be correspondingly more difficult. The prices on this contract were higher than the estimate and the length of section will be cut down to accommodate the funds available.

The third section consists of that part of the river below the lock to where the natural deep water channel begins. No detailed estimates of the cost for dredging have yet been made. It is possible that plans may yet be prepared so that the contract can be let next year.

The federal government has already appropriated and authorized the expenditure of $2,700,000, leaving $1,800,000 yet to come of the amount of $4.500,000 that is thought necessary.

This work is proceeding under strict governmental supervision of Col. Henry M. Adams, the U. S. Engineer in charge of the Buffalo harbor work and Mr. L. L. Davis, Resident Engineer.

Contracts Nos. 2 and 11, Erie canal, cover a distance of 2.51 miles,

Dipper Dredge Fleet on Contract No. 1.

entire length of the Oswego river trom Three River Point to Oswego, and on the line of the Champlain canal from Northumberland northward to Whitehall; also for large storage reservoirs on the Mohawk river at Delta and on the West Canada creek at Hinckley.

Topographic maps have been made from the Montezuma marshes to Pittsford, but all of the data necessary for the preparation of contract plans have not yet been secured.

On the Hudson river from Northumberland to Waterford a portion of the surveys is completed and as soon as ice forms on the Hudson river the center line will be located and borings and soundings taken.

The extent of the surveys made is summarized as follows:

Topography taken, 130 squares miles.

Transit lines run, 1,034 linear miles.

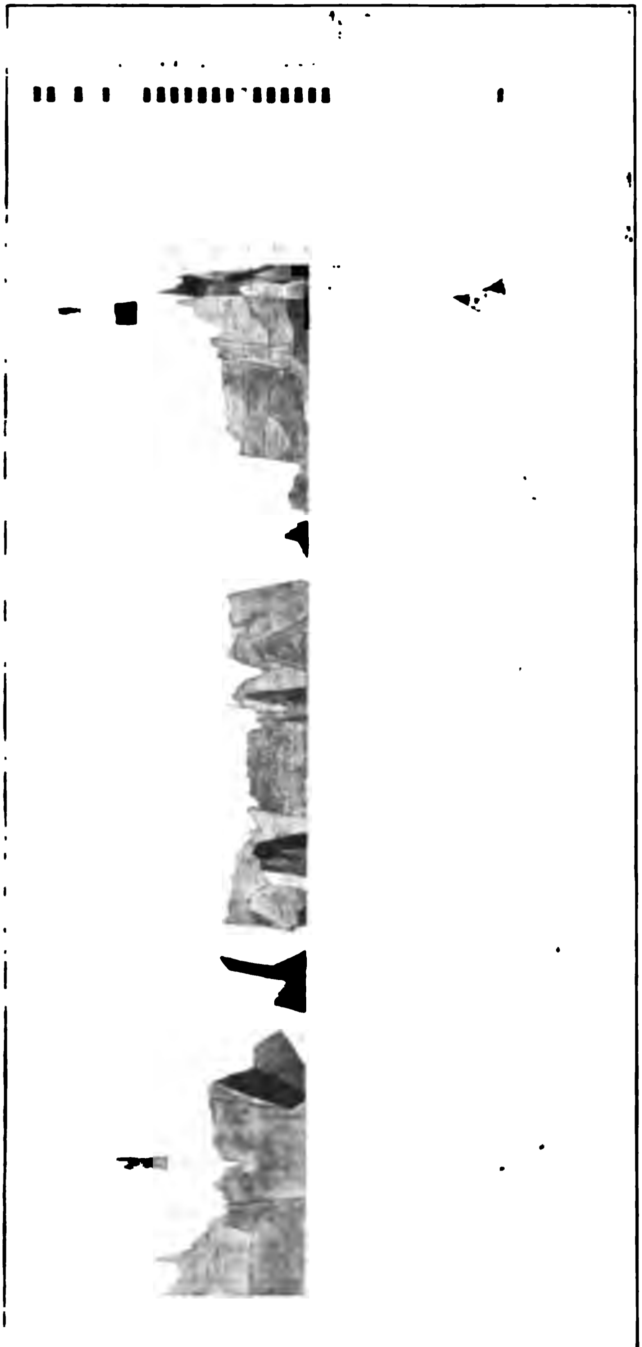
Levels run, 1,428 linear miles.

To determine the nature of the material through which the canal passes, and particularly at lock and dam locations a vast amount of boring has been done. The linear feet borings for which reports have been received to January 1st, is 216,125 feet, or about forty-one miles.

The plans, specifications and estimates have been prepared and have passed the scrutiny of the Advisory Board of Consulting Engineers for twenty-six contract sections, embracing a total of about 209 miles of canal at an estimated cost of $35,000,000. A small map of the State showing the location of this work is herewith presented.

The maps, drawings, specifications and estimates for these contracts are prepared in great detail and care.

The contract drawings accompanying and illustrating the plans, etc., which have passed the Advisory Board number in all 2,062, each 24 x 36 inches in size. On one contract alone which has passed the Board. but which has not yet been let, the sheets of drawings number 218. This is No. 12 and embraces the work of forty-four miles of canal from the western end of Oneida lake to the Seneca river at Mosquito Point. The work embraced in this contract includes 7,102,-yards at an estimated cost of about $2,230,000. There are 187 sheets of drawings illustrating this work. Another contract, No. 30, embraces about twenty-two miles of excavation in the Mohawk river, 200 cubic yards of excavation of all kinds, one lock and much auxiliary work and is estimated to cost about $3,800,000. Another contract section No. 28 embraces thirty-five miles in length of the Mohawk river in which the estimated amount of excavation is 5,000,000 cubic



This illustrates the character of topographical drawings used in determining the material that will be handled on each contract. The drawing is colored to indicate the nature of soil and the plan of the canal straightened to conform to the profile.

the estimated amount of which is very nearly 12,000,000 cubic yards, at an estimated cost of about $2,900,000. There are 157 sheets of drawings, illustrating this work.

The policy pursued in letting this great work by contract is to divide it into sections of varying size and let each section separately by contract after due advertisement and the reception of bids. In determining the size of the sections consideration is given to the desirability of having each one include mainly one particular class of work, and where a considerable plant will be required, to have the section embrace a sufficient amount of work to justify a contractor in furnishing such a plant. For instance, a number of steel bridges are included in one contract; two or three dams and locks on the Mohawk river are included in one contract, while the dredging and excavations between them is included in another. The sections generally have a money value of from $500,000 to $4,000,000.

The method pursued in preparing estimates and letting contracts is worthy of special attention because of its effect in preventing unbalanced bids, or collusions. The Engineer's Department makes a careful estimate of the amount of each particular item or work embraced in the contract, a proper unit price is used for each of these items and the total cost of all the work, based on these estimates of quantities and adopted unit prices, is thus obtained. No bid is accepted which for any item exceeds the item price of the Engineer's estimates by more than 20 per cent., or when the total bid exceeds the Engineer's total estimate by more than 10 per cent.

Another important feature of the work is that all excavation in each section is paid for at one unit price no matter what the material may be. This removes a fruitful sources of trouble and possible collusion and corruption. As careful a determination as practicable is made through borings of the different kinds of material to be encountered. All this information is studied by the engineers in making their unit prices, and is available for the bidders and contractors, and the final composite or unclassified price for the excavation is based thereon.

The method of acquiring the lands needed by the State for canal purposes is as follows: When the State Engineer determies that certain lands and waters are needed for canal purposes, he causes an accurate survey and map of such lands to be made, certifying thereon that the lands are appropriated for the use of the canals of the State. Such map and certificate are filed in the office of the State Engineer and a duplicate copy, duly certified, is filed in the office of the Super-

Dredge "Ontario" operating near Port Byron on a strip of canal crossing Montezuma marshes and entering Seneca river.*

intendent of Public Works, who serves upon the owner of the property a notice of the filing and the date of filing of such map, which notice accurately describes the property which has been so appropriated. The Board of Canal Appraisers and Examiners then opens negotiations for a satisfactory settlement with the owners. If this is accomplished the Board of Appraisers certify the amount to the Canal Board, and the money is paid upon the owner furnishing a proper deed. If a satisfactory agreement cannot be arrived at by the Board of Appraisers and the owner, the owner can then go to the Court of Claims, where an award is made for the property so taken, after hearing the proper evidence in relation thereto.

Detailed plans and estimates for about 114 miles, as shown in the following schedule, are in various stages of completion, and will be perfected by December 1, 1907, so that if deemed advisable by the State authorities there can be placed under a contract a total of about 324 miles, covering about 70 per cent. of the entire cost of the canal and about 70 per cent. of its total length.

	Miles	
Fonda to Utica, six locks and dams and all work at Little Falls and Jacksonburg................	6.4	$4,300,000
Utica to Fort Bull.............................	16.0	4,500,000

*Mr. F. K. Lykons of the Empire Eng. Corp. is in charge of the work on this contract (No. 5).

Oswego Canal	20.8	3,300,000
Baldwinsville	0.5	700,000
Pittsford to Contract No. 6 and Rochester harbor	11.5	6,000,000
South Greece to Sulphur Spring..................	58.8	12,700,000
Lock Gates, etc.	....	300,000
	114.0	
Water Supply		4,700,000
Total		36,500,000

It was the opinion of this Board that the successful completion of the canal at the earliest date possible requires that the Contracts Nos. 12, 13, 14, 20, 26, 28, and 35, should receive the attention of the Canal Board and be advertised for bids during the early spring or summer of 1907. The contracts range from $650,000 to $3,500,000 each, and the character of the work is such that heavy and expensive machinery will be required to successfully handle it. A considerable time will be required for the completion of each contract; and bidders should have an opportunity to thoroughly investigate the work in order that they may bid intelligently and feel that there are presented to them inducements in the way of prospects of steady work of a size sufficient

Cutters of dredge [illegible] the cutters.

Aside from these commissions Governor Black had appointed, under chapter 644 of the laws of 1898, the "New York Commerce Commission" and this commission was retained by Governor Roosevelt under authority of chapter 404 of the laws of 1899.

The primary object of this commission was to examine the conditions affecting the commerce of New York City. The study of this subject was a work of considerable magnitude and the committees report covers 122 printed pages. Of this report one-fifth of the matter relates to and is carried under the heading "The Canals."

From the reports by these committees was born "Chap. 411 of the laws of 1899," which appropriated $200,000 for the purpose of surveys and estimates for a Barge Canal from Lake Erie to the Hudson River. The results of this survey and estimate are embodied in "Report on Barge Canal 1901"; being a part of the State Engineer's (Edward A. Bond) report of that date. This report has no precedent as a State document bearing on an artificial waterway and engineering problem.

Following this report came Chap. 147 of the laws of 1903, which authorized the issuing of bonds to the total amount of $101,000,000 for the purpose of building a Barge Canal from the Hudson River to Lake Champlain at Whitehall and to Lake Erie at Oswego and Buffalo. It is under this law, with some minor amendments, that the present work is being carried on.

Governor Black's Committee on Canals—George Clinton, Franklin Edson, Smith M. Weed, Darwin R. James, Frank Brainard, A. Foster Higgins and William McEchron.

New York Commerce Commission—Charles A. Schieren, chairman; Andrew H. Green, C. C. Shayne, Hugh Kelly, Alexander R. Smith, secretary; Ben L. Fairchild, counsel.

Governor Roosevelt's Committee on Canals—Francis V. Green, chairman; George E. Green, John N. Scatcherd, Thomas W. Symons, Frank S. Witherbee, Edward A. Bond, state engineer; John N. Partridge, supt. public works; John A. Fairlie, secretary.

The construction of this canal has given rise to problems in excavation very similar to those solved in the Chicago Drainage Canal work and the devices used on the various divisions bid fair to rival in interest the ones used there.

Each contractor must, from his knowledge of the material to be handled, choose ways and means to do the work and in some cases it is being done with machines inadequate to the rapid completion of the canal. No contractor should attempt to apply methods for this

these dredges are worked in three shifts, those near Port Byron from 7 to 3, 3 to 11 and 11 to 7, while at Sylvan Beach they work from 8 to 4, 4 to 12 and 12 to 8, making eight hours per each man.

No delay is caused by wet weather, the soil can be handled just as well when it is raining as when the sun is shining its hottest and the spoil carried to the fields just as easily. These dredges advance from 100 to 150 feet a day of 24 hours and cut the full width and depth of the canal, although at some points a smaller machine will be used to trim up the edges and bottom. At Sylvan Beach a Lubecker trencher is used to cut out a ditch inside the line of the canal and deposit its material as a bank for the spoil field and it is only necessary to throw up the back and cross banks by hand or scraper.

On a contract covering a length of over two miles of heavy cutting near Rochester, N. Y., F. A. Maselli & Co. have a truss machine using a grab bucket to excavate material from the canal bed. The truss is about 425 feet long and towers 50 feet high and designed to travel on standard gage track on each of the cuts. This machine weighs about 350 tons and carries a bucket of about 8 cubic yards capacity and was designed to load automatically with earth which had been broken up well. This machine began operation in the spring of 1906, but it was soon found that not more than 2 or 3 cubic yards could be handled with the bucket. However, this was used until February, 1907, when a steam shovel was installed to load the bucket. The grab was still continued to strip the earth surface. This machine was electrically driven by power from Rochester and the following gang was needed to operate the plant: the operator in the cab over the bucket, six laborers and a foreman. When the shovel was added to the plant extra men were needed for that and the dumping machines.

It is thought that the truss machines cannot be a paying proposition unless a very large amount of work can be secured.

It would seem that the suction dredge, where it has water to float it, would be the most suitable machine for canal construction.

Fig. 2. Lower part of line.

meters above the sea level The end of the first section which is 1,230 meters long and 484 meters above the first station lies at a height of 1,859 meters above the sea level. Between these two stations there are a number of intermediate tightening stations and supports at a maximum distance of 400 meters apart. On this section the cable for carrying the loaded cars is of spiral steel rope 24 mm. in diameter with a strength of 150 kg. per square mm., the rope for supporting the empty cars being of the same quality and having a diameter of 18 mm.

The second section includes a span 1,250 meters in length the difference in height being 700 mm. while the third section is 1,350 meters long, rising 600 meters higher, the upper station being 3,200 meters above the sea level. The cables on these sections for the

Fig. 3. Exterior of the Power Station.

Fig. 4. Interior of Power Station at the lower part. Turbine of 80 H. P.

Fig. 5. Interior part of the Power Station.

Fig. 6.

tion of the fortress in the Alps was 300,000 lire or about $60,000, of which 90,000 lire or about $18,000 represents the iron construction and the installation.

This Italian rope railway is of particular interest on account of the two very long spans one of which is shown in the accompanying illustration.

Clearing Wrecks at Sea.

THE ingenuity displayed in handling a wreck at sea is remarkable, due to the fact that there is not much to tie to. With the railroad man there is the huge crane, the jacks and tackles, and perhaps a big tree near by that can be used as a "dead man." To pick up a boat, even be it small, is no easy task and of late, special crafts are being built to aid in collisions and other disasters. On the Great Lakes there is a

Wrecking Tug Favorite.

Giant derrick lifting ferryboat "Bay Ridge" from the water at the Battery.

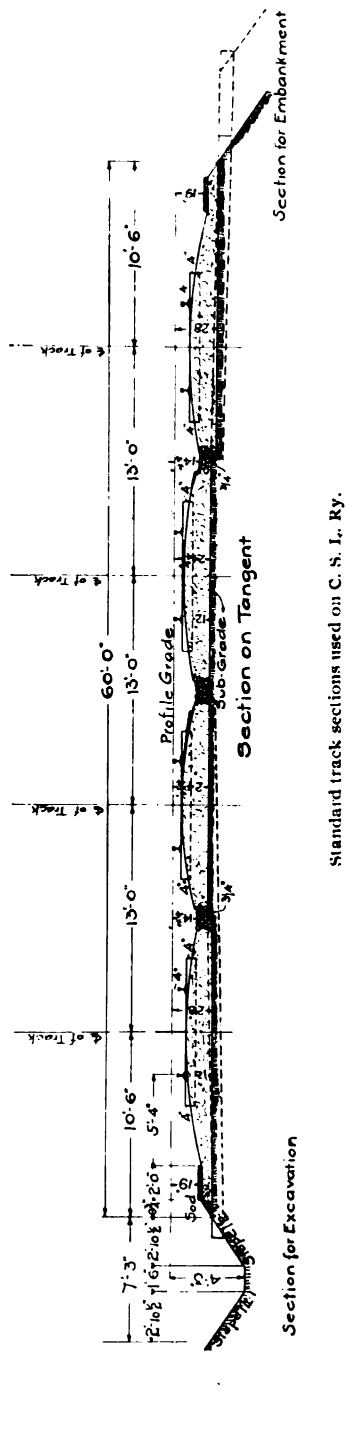
new boat, named the "Favorite" stationed during the season of 1907 at St. Ignace, Mich., and subject to call to any of the lake ports. A long distance telephone is installed on board and the crew are ready for action either day or night. The "Favorite" is the most complete wrecking

steamer in the world and is capable of going anywhere in all weather.

There is another branch of marine service that is receiving considerable attention now, and that is the destroying of derelicts. These helpless water-logged castaways that drift along with the current year after year are a constant menace to the ships in whose track they may arrive. It is true that some desultory attempts have been made from time to time by the Navy and Revenue Cutter Service to destroy this class of the derelict, but an organized crusade has only recently been taken up and on April 30th the offices of the United States Government opened bids for the first derelict destroyer.

This ship, Revenue Cutter No. 17, will be 204 feet long, 34 foot beam and carrying machinery of 1,500 horse power.

Four 6-powder rapid fire guns will be mounted on the spare deck for protection and for creating damage to derelicts, which can often be sunk by shots.



This line is being built for four main tracks in ultimate development, with two additional tracks provided for in the masonry, except that the two thousand foot viaduct over the Cuyahoga Valley is only double track; the bridges and culverts are all built to carry the heaviest modern locomotives, and all the construction is of the most substantial type known to engineers. Eighty-pound rails will be used with oak ties, all plated. There are no grade crossings of public highways upon the line and it will go over or under nearly all the railways it crosses. Its steepest grade is 15′ 10″ per mile, to accomplish which heavy excavation and embankment work is undertaken.

The maximum degree of curvature will be 3°. On the ten miles of road under construction now there is only one curve; this is a 30-minute curve between Station 110 and 180. From Sta. 0 to Sta. 110 the road is tangent, about S. 30° W. From Sta. 110 to Sta. 180 it curves 30°, then runs tangent to Sta. 540.

It will be remarkable in comparison with most belt lines in the difficult character of the country traversed; not far east of the crossing of the C. L. & W. Ry. in Brooklyn Heights it runs through a cut seventy-two feet deep in rock and shale, while at the Cuyahoga River it crosses the valley on a viaduct 1,980 feet long, 157 feet high, and in the embankment then succeeding there will be over one and one-quarter million yards of earth when finished. The grading is to be completed by September, 1908.

The estimated cost of this line is $8,-000,000.00. The line will be 19.3 miles long. The portion from the Lake Shore connection near Berea to the Big Four

Ry. is built and the track laid and ballasted; from this point on east, steady progress is being made and many different kinds of work are under way; at one place drilling and blasting of rock continually is going on; at other points highway crossings are being put overhead or underneath; while this crossing work is under way, the railway company has laid wide plank crossings at each highway crossing at one side of the work for public highway traffic.

At the Cuyahoga River crossing very substantial masonry is being erected and the sight is an interesting one; the viaduct at this point will be one of the greatest bridges of the United States; it is planned to have twenty-nine spans and will aggregate 4,150 tons of steel, and will cost roughly $800,000.00. The American Bridge Company and The Lucius Company have the contracts for the bridge erection.

The bridges over the highways are plate girders, with the steel floor system filled in solidly with concrete and an upper course of asphalt and felt to make a water tight and durable floor, upon which is placed the ballast and track.

There are about 500 men at work at present. There are six steam shovels, four excavators drawn by traction engines, 100 teams, and 16 dirt trains, operating over the present scope of the work. West of the Cuyahoga River standard gauge 12-yard Western automatic dump cars

Construction work for steel viaduct across Cuyahoga Valley. Bridge designed by American Bridge Company. Concrete work put in by Dunn & Keith.

Making concrete abutments for a railroad bridge over Parma Road.

are used. There are 6 trains of these, running 10 cars to a train. East of the river ten 3-ft. gauge trains are run, with from eight to ten cars to a train. The stores are kept at the West Park Yard, at the westerly end of the line and distributed over the work by a work train on the tracks already completed or by the contractor over his temporary trackage. The track is being laid by the push car method.

At Sta. 18 the road crosses Marcelline Avenue. The tracks will be laid under the highway here and a 90-ft. span steel girder bridge with concrete abutments is being built. The abutments will rest on piles which are being driven 35 feet to a shale bottom. The excavation work here is being handled by a traction engine and an excavator loading into dump wagons. The dirt excavated is used in making the highway approaches to the bridge.

The work on the big fill at Rodway Cor., Stas. 50-67, was started in June, 1906. It is 115′ deep at the deepest point and will require one million and a quarter cubic yards of dirt. The first lift of this fill was taken from borrow in a hill adjoining, and was carried to a height of 70′ at the deepest point. This work required about 8 months. The second lift is being made from material brought in from borrow a mile east of the work. The original intention was to complete the fill to a finished grade with this second lift, but owing to the difficulty in maintaining the trestle work on top of the material placed in the first lift it was decided to construct the fill to within about 20 feet of the grade, and then complete the fill with a third lift. Two lifts are being made at the same time. A Bucyrus shovel, operating on a grade with the lower lift, is excavating material in a hill adjoining. Three trains of 6 cars each haul the dirt. The upper lift is made by trains running out over a temporary trestle.

The steel viaduct across the Cuyahoga River, Stations 89-109, will rival the biggest railroad bridges in the United States and other countries. There will be 15 spans, the longest one being 180 feet across the Cuyahoga River. This bridge also crosses the Ohio Canal with a span of 100 feet, and the tracks of the Cleveland Terminal and Valley Railroad with a span of 114 feet. The reinforced concrete abutments will be about 60 feet high and will rest on a bed rock of shale. There are 56 concrete pedestals which, with the exception of sixteen, will rest on piles driven to shale. These sixteen pedestals will be set right on the rock foundation. The viaduct will have a grade of 0.3% from east to west.

At Station 117 there is being constructed a pipe culvert to take care of a small creek. About 450 feet of 42-inch cast iron pipes are being laid in reinforced concrete. The creek flows north, and in order to get the necessary information to drive the piling for the concrete base of the culvert a boring was made at the south end of the line of the culvert. Shale was reached at a depth of 29 feet and proved to have a dip of 10 feet in 400 toward the south. The piles were then driven from 22 feet to

Temporary trestle work for a 200,000 yard fill. The piles in the center were not long enough and a pony trestle was built on them. Sta. 117. C. Short L. Ry.

in sandstone. There are 568,000 yards in this cut, which will be distributed to the fill at Sta. 117 and to make a six track roadbed from Sta. 320 to Sta. 400. The material to be cut is divided about equally between sand, clay and shale.

About 25 tons of a mixture of 60% black powder and 40% dynamite have already been used in blasting out the rock in the sandstone cut. The fill from Sta. 320 to Sta. 400 is being made from a trestle, from 5 feet to 35 feet high.

The concrete masonry on The Cleveland Short Line Railway has been done under the superintendence of Dunn & Keith, of Cleveland, Ohio. The work was commenced in August, 1906, and has progressed steadily since that time. There has been completed during 1906, one 24 ft. arch at Station 480, one 10 ft. arch at Station 456, one 10 ft. arch at Station 390, one 50 ft. arch at Station 360, one 8 ft. arch at Station 330, one 6 ft. arch at Station 290, one pair of abutments at Station 480, one 4 ft. x 4 ft. box culvert at Station 70, and an abutment and 36 pedestals at Station 100. About 40,000 cubic yards of concrete have been placed already.

The materials found for foundations, from Station 480 to Station 290, consisted of shale, and clay almost as hard. Quick sand was encountered on all the other work and it was necessary to drive piling varying from 25 to 50 feet, to a substantial foundation. Where it was impracticable to drive piling, excavations were made for foundations to depths varying from 45 to 90 feet to a rock or shale foundation.

In the construction of this work Dunn & Keith had an equipment consisting of six 2½ Smith Concrete Mixers, together with hoisting engines, guy derricks, steam pumps and boilers, and other smaller machinery, which make up and complete the outfit. In making the deep excavations 3-inch sheet piling was used and 12 x 12 timber for bracing. The heavy timber was necessary on account of the great pressure of quick sand and water.

The concrete was placed in the forms by means of derricks and one yard concrete buckets.

There is yet to be constructed five arches, one of which is a triple reinforced arch, with Raymond concrete piling, for foundation. The entire work will probably be completed by December 1, 1907.

The concrete work at Parma Road is typical of the work done for the highway bridges. On either side of the road there is an abutment, and seven pedestals for the supporting columns. These steel columns will be between the sidewalk and the road. The abutments and pedestals will contain about 2,500 cubic yards of concrete.

A 50 ft. concrete arch culvert built by Dunn & Keith for the C. S. L. Ry. at Sta. 360

The stone and sand are dumped onto the mixing platform directly from the railroad cars. The cement is stored in a shed on the platform. A mixture of 1 cement, 2 sand, 5 stone, has been used on all the work. The concrete is taken from the mixer in a bucket by a guy derrick with an 80-ft. boom, and dumped into the form.

One of the prettiest pieces of work on the road is the 50-ft. arch culvert built by Dunn & Keith at Sta. 360. The drawings illustrated here give the general and some detail dimensions, and the dimensions for the spacing of the reinforcement. This culvert was completed a short time ago and is to take care of an extensive drainage area.

Modern Developments in the Art of Conveying Materials.

By W. R. Hurlburt, M. E.

THE art of conveying materials is one of the most important, as well as one of the oldest of all known arts; yet it is one which has been developed along scientific lines only within recent years. Its progress, however, has been coincident with development in other important arts which have remained at a standstill for centuries until American enterprise and genius lifted them from the low plane upon which they had stood to the high state of efficiency which marks the present status of engineering accomplishment.

In the words of Mr. Henry R. Towne, in an address delivered recently before the American Society of Mechanical Engineers, "About sixty years ago, American invention lifted one of the earliest and universal of the manual arts from the plane upon which it had stood from the dawn of civilization to the high level of modern mechanical industry. This was the achievement of the sewing machine. About thirty years ago, American invention again took one of the oldest of the manual arts, that of writing, and brought it fairly within the scope of modern mechanical development. This was the achievement of the typewriting machine." Mr. Towne then went on to point out that the art of cutting metals had remained practically unchanged until Mr. F. W. Taylor made his recent researches into the subject and lifted it at once from the plane of empiricism and tradition to the high level of modern science and apparently had gone far to reduce it to an exact science.

What could be older, however, than the art of conveying materials; it stands to reason that it must have been the first subject to which primitive man turned his attention, yet through all the ages that have passed since then, there has been practically no development in this most important of arts. The original method of conveying materials, i. e. by manual labor, may still be witnessed to-day. The second method, by means of skids or rollers, may also be seen to-day. Likewise the third method which includes the wheelbarrow and the cart. All these methods were in general use up to the period of the last century and are still very generally used, not because there

are not better methods but because the better methods have not had time to be adopted as yet in all lines of industry.

The first step toward improvement was made A. D. 1600 in England where the heavy roads leading from the mines to the seaports greatly interfered with the shipment of coal and other minerals to the markets. Here the idea was conceived of laying planks in the wagon ruts and so forming a "plankway" over which rough carts fitted with clumsy wooden wheels or rollers and laden with coal and ore naturally made far better progress than formerly. It was only a little while after this that the planks were placed on the surface of the road and supported at fairly regular intervals by cross ties. This might be called the first industrial railroad and was further improved by filling in the spaces between the planks with dirt so as not to interfere with the progress of horses and mules which were employed to haul the carts. It was found that a horse could then easily pull a load of 42 cwt. as against 17 cwt. over the old rough roads.

The wooden "plankways" were replaced by cast iron rails about a hundred years later (in 1767), the Colebrook Iron Company of England having perfected such a rail with an upright flange on the

The industrial railway and cars handling soft material.

inner side. From this time on the industrial railroad developed rapidly until to-day it seems to have reached its limit in efficiency and usefulness.

The industrial railroad, however, is essentially for long distance hauls, i. e. hauls in excess of 2,000 feet. For shorter distances a much better system has been perfected, that of the belt conveyor. This is undoubtdly the most important development in recent years and its advantages are most pronounced. For instance, with almost any other system, it is necessary to construct a road-bed or supporting trestle strong enough to withstand the strain of a heavy moving train in which the load is contained in a few cars, in other words, the load is concentrated on a short length of the trestle which must be made not only strong enough to carry the load but to support the additional weight of heavy steel cars or locomotives. Furthermore, the motive power must be sufficient to start this train while loaded, which means that ample power must be provided for starting a train that only requires a fraction of this energy to keep it in motion after it has once gained headway.

A Conveyor for handling coal to boiler house. Robins Conveying Belt Co., N. Y.

The construction of the idler pulleys is also a very important matter, for, while the belt is running on the upper, or troughed pulleys, there is no danger of grit getting into the bearings of the idlers, yet, when it is running in the return direction, it is moving "face down" and has a tendency to deposit particles of dust and grit on the supporting pulleys. For this reason they have to be constructed with absolutely dust-proof bearings. This has been one of the most difficult problems which engineers were called upon to solve in perfecting the belt conveyor and the fact that it has been correctly solved is responsible for the growing demand for this class of machinery to-day; a demand that emanates from every quarter of the globe and from all classes of trade and industry. From the power house with its boilers and giant coal pockets, the very symbol of dirt and grime, to the packing plant where cleanliness is prerequisite, may seem a far cry but it is not too great a breach to be spanned by the conveying belt which will be found working to its full capacity in each.

One of the most interesting sights in the Chicago Stockyards is the way the belt conveyor is utilized for handling meats. A whole carcass will be thrown on a conveyor at one end of a long table and by the time it reaches the other end, after passing along a line of butchers, it will be cut up into chops and steaks, and this in less time than it takes to tell it.

But the most important field for the conveying belt is undoubtedly in its application to manufacturing plants. It has been carefully computed in many instances that the cost of handling materials in such establishments amounts, on the average, to one-fourth of the cost of producing the finished product. Certainly a very high proportionate cost and one which is constantly being wrestled with in all classes of industry. For instance, one of the most difficult problems which has occupied the attention of engineers for a great many years is the proper handling of material in pulp and paper mills. Here, increased output, caused by greater demand together with keen competition rendered the problem one of prime importance. All kinds of conveyors were tried, scraper conveyors, grain conveyors, etc., but without success. The belt conveyor, however, proved to be the solution to the problem and may now be found in hundreds of paper and pulp mills throughout the country.

Coal handling is another very important field for the belt conveyor and one which has received considerable attention within the last few years, not only in connection with power plant work, but also in connection with retail coal pockets, locomotive coaling stations,

manufacturing plants, etc. Under the old system it was necessary to build a long trestle and lead the coal cars to the top of the pocket before discharging the load. Where belt conveyors are used, however, the trestle is comparatively light and inexpensive and the rate at which coal is stored is limited only by the size of the conveyor. A thousand tons an hour can be readily handled on a 42-inch belt.

Coal mines also furnish a promising field for installations of this kind as there are many operations such as picking and sorting, where a slow moving belt is of material assistance in leading the ore past rows of pickers, the speed being set to keep the men working to their most efficient capacity. Conveyors are also advantageously employed for stacking tailings behind dredges and mills and for numerous other work in connection with mine operations.

Conveyor in the store of B. Altman & Co., New York

Another instance of their adaptability is to be found in the case of the modern department store where the rapid handling of packages is a vital necessity to the success of the business. This was found to be especially the case in the new store of B. Altman & Co. on Fifth Avenue, New York, which is patronized by a class of customers who would not think of carrying a package as small as a pair of gloves or a spool of thread. Everything must be delivered. So we find that in this establishment the entire basement, which in most department stores is used as a salesroom, is given over to the shipping department. In order, however, that packages may be delivered to the wrappers and shipping clerks with least delay and handling, this firm has installed a most elaborate, yet simple, system of spiral chutes and belt

conveyors so that packages may be dropped into a chute on the top floor in any corner of the building and be led automatically to a conveying belt which carries them to a distributing table in the center of the basement from which they are taken by the wrappers and shipping clerks for the various delivery routes.

The spiral chutes or "helical gravity tubes," as they are called, are 4 ft. 6 in. in diameter and are capable of delivering safely almost any kind of a package except glassware and crockery. The conveyors are four in number and consist of 30 and 36 in. belts running at a uniform speed of 150 ft. per minute the lengths varying from 71 to 191 feet. Three of these conveyors are troughed belts 30 inches in width while the fourth is a flat belt 36 inches in width, designed to carry unwrapped packages to a separate distributing table where they are specially wrapped for shipment by express.

These conveyors, as will be seen from the illustrations, are suspended by a very light steel structure from the ceiling, the height of the belt above the floor being 9 feet, thus giving ample head room while the space above the belt is sufficient to permit of the passage of packages 7 x 20 x 36 inches in size. The three short belts are operated by 3 horsepower electric motors and the large belt by a 5 horsepower motor.

The striking feature of this apparatus, however, is the absence of noise and freedom from dirt and grease, making an ideal installation for large department stores which are confronted with the problem of handling packages with the utmost expedition.

The applications of these time and labor saving appliances could be enumerated indefinitely and then the chances are that the subject would not be fully covered. There is one application, however, that should be mentioned, and that is the use of belt conveyors for the handling of concrete materials and even wet concrete itself.

During the past few years the use of reinforced concrete has grown to enormous proportions. Machinery of all kinds has been perfected for mixing it, volumes have been written upon its proper use in construction work, special apparatus has been designed for economically handling the materials which are to be fed to the mixer, but very little has been done towards bettering the methods of handling wet concrete after it comes from the mixer. In fact wheelbarrows seem to be the almost universal mode of conveying this material at the present time.

The writer is convinced, however, that the conveying belt will prove the solution to this problem as it has to most others of a similar

nature. In fact belt conveyors have already been used in construction work of considerable size and importance for this purpose and with much success, the results being so satisfactory that other and much larger installations are now being planned. If these attain the success which is confidently predicted for them, then, indeed, will the conveying belt have achieved its most remarkable victory, opening up a field of infinite possibilities both for itself and for the success of reinforced concrete construction.

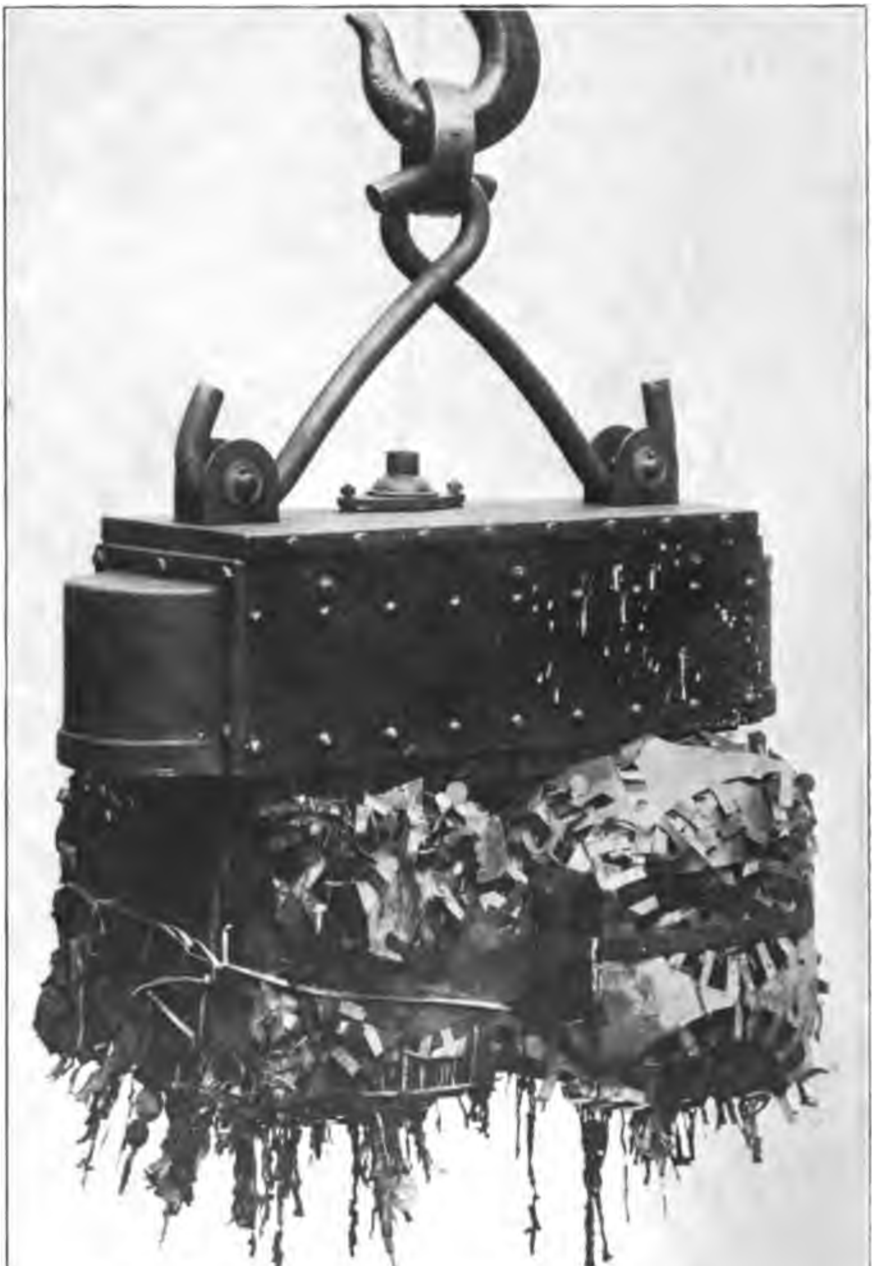


Fig. 1—Square Type Magnet with baled scrap.

The Electric Magnet in Practical Use.

THE electric magnet for use in shops and yards is becoming more desired every day, and those who have not acquired them are perhaps not fully informed on the many advantages.

The experiments with electric magnets date back to 1820, when Oersted discovered that a conductor conveying an electric current gave off magnetic influences. Since that time many noted men have experimented with and built magnets but none succeeded in a practical demonstration until Mr. S. T. Wellman exerted greater influence in this direction and their use became assured. To Mr. Wellman, the electric magnet offered an ideal remedy for the many difficulties of handling plates, billets, scrap and hot ingots.

The first magnet was built and lasted long enough to demonstrate the possible of the qualities of such a machine in its crude form but it was enough that Mr. Wellman realized its great possibilities. Mr. Wellman then undertook the design of an electro-magnet, which, as far as shown by the records of the U. S. Patent Office was the first dis-

Locomotive crane handling scrap with a magnet

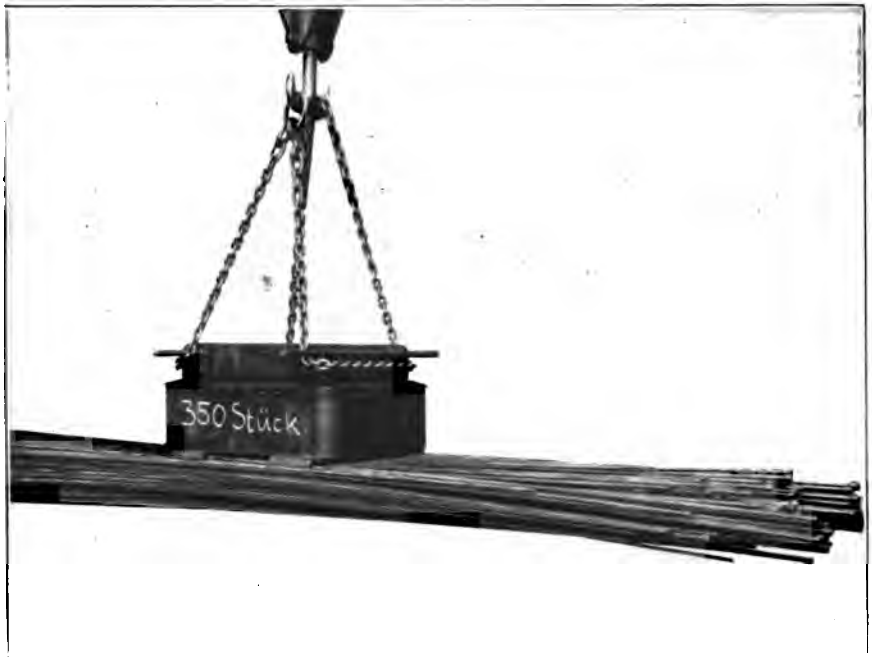


Fig. 3—Square type magnet handling pipe.

Fig. 4—Round type magnet handling bar iron.

Fig. 5—Round type magnet with a dynamo casting.

tinctive "lifting magnet." The designs of magnets were further advanced by Mr. Eugene B. Clark of the Illinois Steel Co., and later by Mr. A. C. Eastwood of the Electric Controller and Supply Co., Cleveland. In all designs, the feature of protection of the magnetizing windings is uppermost in the minds of builders.

There is, of course, the necessity of an electric plant, from which a thoroughly reliable current can be obtained. In the modern, up-to-date manufacturing plant, which is equipped electrically, the matter of using a magnet is becoming more and more largely understood, but in cases

Fig. 6—A magnet in a railway yard.

Fig. 7—Old style trip for scrap breaker.

where cranes and other hoisting apparatus are steam driven, the necessity for a generator is evident.

There are concerns who are building small generator sets, composed of an engine and dynamo direct connected from which sufficient current is secured to operate a good size magnet.

Magnets are now being built in sizes ranging from 24" diameter to 60" diameter in this country and of the square type in foreign as well as this country there is a great variety.

A few of the uses of the magnets will be seen in the accompanying illustrations, but no one of them showing the apparatus in a better service than handling scrap. No other means has been devised for handling the product and shipment and also the refuse in railway yards and factories as the electric magnet. The use of the magnet has been successfully demonstrated in both this and foreign countries, and Fig. No. 1 illustrates the square type of magnet made by the Siemans-Schuckert-Werke of Berlin.

In Fig. 2 we have a familiar scene of the locomotive crane and magnet handling scrap iron from a pile to a car. Only one operator is required in this case, and he has full control in the cab of the crane. A small generator set is located in the cab of the crane from which sufficient current is obtained to energize the magnet. This magnet of 36" diameter requires 20 amperes at 220 voltage to handle the material successfully and so operating at a speed of 60 tons per hour, each load averaging 1,000 pounds.

In Fig. 3 we have a magnet of foreign make lifting 350 lengths of pipe.

In Fig. 4 we have a magnet of The Browning Engineering Company of Cleveland, O., handling bar iron. In this case the load is not evenly distributed and tilted up in the position shown.

In case of over-head traveling cranes the motors are operated by alternating current, but the magnets by direct current, and the current is carried to the magnet on independent wires that can in no way be affected by the operation of the crane.

In Fig. 5 is a circular type of magnet, handling a part of the dynamo frame, weighing 2612 kilograms, and it will be seen that the means of support is applied at three points, giving a very much more stable holding power to the load.

Every railway yard where a great variety of iron and steel have to be handled, the electric magnet has no equal.

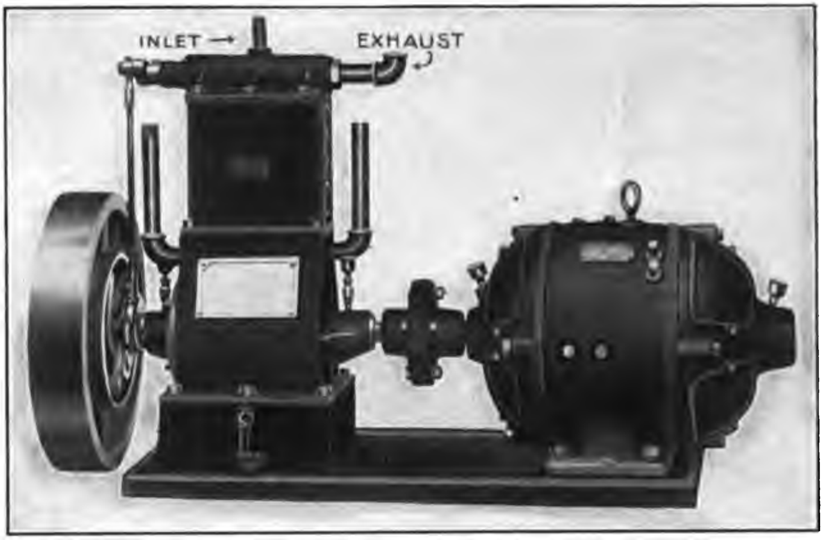


Fig. 8—Generator set for locomotive crane.

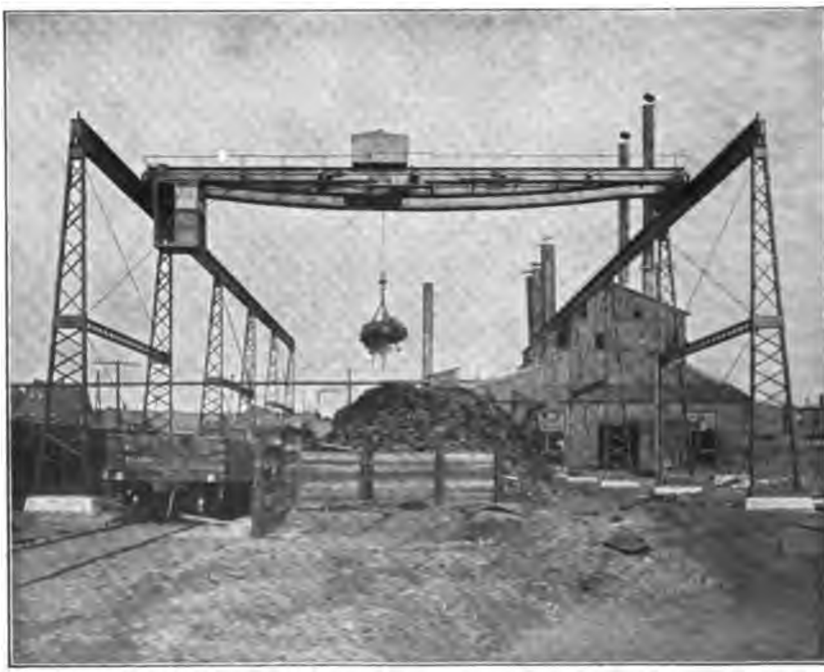


Fig. 9—E. C. & S. Co. magnet on a traveling crane.

In Fig. 6 the magnet of 36" diameter handles 6 axles with ease, and the same machine is also shown in Fig. 7, where the wheels and axles are being carried to another part of the yard.

An E. C. & S. Co. magnet unloaded a car of 61,000 lbs. net, of butt or heavy crop ends (many pieces weighing over 500 lbs.) in 1½ hrs., and each lift had to be hoisted 15 ft. to clear a box car, trolleyed 20 ft. and carried 75 ft. down the yard. In this record it was evident that at least one hour was consumed in crane travel.

Plates of any thickness can be handled singly, or a number at a time, and loaded or unloaded rapidly and without ground helpers. If they are to be carried over workmen we suggest the use of auxiliary hooks which are easily adjusted after the magnet lifts the load but this will require a ground helper. Long plates are better handled by using two or more magnets on a beam.

A pig magnet 35" in diameter weighing about 1,700 lbs. will, when properly handled, carry an average of 500 pounds at a lift, no labor being required except that of the crane operator. For lifting a huge ball of iron for braking iron, the magnet saves a great amount of time and is not as dangerous as with the hook and trip type of grip.

A Name.

If a doctor violates the ethics of his profession he is a "quack."

If a lawyer does the same thing he is a "pettifogger."

If a member of the chamber of commerce defies its rules he is guilty of "unmercantile conduct."

Why can't laboring men have their organizations also?

This is the proposition presented by Samuel Gompers, president of the American Federation of Labor, at the southern Ohio Chautauqua.

"Thou shalt not take thy neighbor's job, is one of our rules," he said. "Can you wonder that we also have a name for him who violates that rule?"

The name is "scab."

If an engineer or a draftsman takes another man's job (position is the proper term) what shall we call him?

No trouble has been experienced in these occupations so the coining of a name has not become necessary.

Industrial Insurance.

It may be doubted whether the improvements now effected will go far to convince the intelligent public that industrial insurance is not a very clumsy and wasteful institution. We do not remember that any disinterested writer who has ever looked into this field of our national economy has spoken of industrial insurance as anything more than a makeshift institution, only to be tolerated until some less wasteful system was found practicable. Industrial insurance is generally regarded as "thrift." Indeed one of its chief apostles has claimed for it that it is the greatest educational influence making for thrift that exists at the present day. Well, thrift and extravagance are relative terms. In the absence of a clear and authoritative line of demarcation between them, everybody can have his own opinion about an institution which compels a man to put up a dollar in order to get back 35 cents of it when he dies. Out of every dollar paid as premiums on industrial policies it has been calculated that 35 cents goes to death claims and another 35 cents to expenses of management. In 1905 the two companies above mentioned paid nearly as much for agency and home-office expenses as they paid policyholders in the shape of claims. In the 29 years from 1876 to 1904, there was paid to the industrial insurance companies of this country, by way of premiums, $845,385,672. The losses paid back during the same period amount to $260,069,267. The rest of the money has either been spent in managment expenses or has gone toward stockholder dividends or toward the accumulation of assets and surplus.—Harold Seymour in *Moody's Magazine.*

Taft and the Canal.

The report from Washington that Secretary Taft is about to take heroic measures at Panama should surprise none who have given close attention to the course of events.

The history of the Panama enterprise has been distinctive in the number of men of high reputation who have undertaken the task only to abandon it. One after another they have come and gone—Chief Engineer Wallace, Chief Engineer Stevens, Chief Commissionr Shonts.

And now Lieut. Col. Goethals, the latest chief engineer, is reported to be asking for a long leave of absence. Three other members of the commission, two of them army engineers, are reported to be desirous of other assignments.

TO SAVE MOTIVE POWER.

The plan of increasing the minimum weights is taken as a defensive move by the Ohio railroads, to protect themselves against the recent car ruling of the Ohio State Railroad Commission, authorizing shippers to compel the roads to accept sliding or reciprocal arrangements for car service.

Railroad men say that the increase in carload weights will effect a saving in motive power as well as in cars. While the difference in one car is not considerable, in the aggregate it will mean a big saving in cars for the railroad. Shippers having car service agreements heretofore could demand a car for a 30,000 pound shipment but now they must load 36,000 poudds or wait until they have that much material before they can obtain a car. It is while this 6,000 pounds is being obtained that the railroads will effect the saving, and, they say, prevent a shortage of cars.

Widening Prosperity.

Great commercial nations, trading with the world, have support for their industries in many widely separated and wholly unlike regions. They may find ten important customers flourishing when one suffers from bad crops or some other cause of lessened purchasing power. Misfortune is not likely to affect all or a majority of the countries which buy the surplus manufactures of England or Germany, in any one year. It is like the weather and the harvests in a land of immense extent like the United States. Conditions may be bad in half a dozen States but hardly in forty-five.

American industries rest, to an ever increasing extent, upon foreign markets, in one important sense, though not in others. The export trade of the country is not larger, in proportion to domestic traffic, than it was a generation ago, but it touches a much wider range of industries. More divisions of the business of the American people are sending abroad a considerable part of their products, though in some branches of industry, as in agriculture, the proportion exported is much smaller than it used to be.

The effect upon American trade and industry of good or bad times in Europe, for example, is also heightened now by the much more intimate and complex relations between modern commercial nations. The civilized world is more closely knit together. It is subject, more than it used to be, to waves of feeling, favorable or adverse to the prosecution of new enterprises and the widening of commercial and industrial activity. Europe is more senstive to American influences and America responds more to the average European state of mind.

It is of immense and growing importance, therefore, that the countries which are the best customers of the United States should prosper. When they are doing well they buy more freely in this country and pay better prices. And the influence which they exert upon the business mind of America is then a tonic rather than a cause of depression.

For the last few years the general state of trade and productive industry in Europe has been remarkably good. The people of Germany, Great Britain and Ireland, Italy, Austria-Hungary, France and several lesser states have had better conditions of living than ever before. Wages have been rising. Work has been easier to find and keep. The standard of comfort for the masses has been changing for the better. The times have been the best ever known.

Obviously, all this makes the base of prosperity broader and more secure in the United States. It establishes a firmer foundation for American trade and American industries of many kinds. It is a factor in the business outlook which is often underestimated in forecasts of trade conditions and the opportunities for profitable financial and industrial activity.

Public Utilities.

Some striking ideas in legislative control of public utilities are expressed in the public utilities bill which will now be put into effect in New York state as a consequence of the signing of the bill by the governor on June 6. The provisions of the bill have been called radical by those who may be expected to feel the effect of it most directly, and certain of the provisions at least will be innovations in governmental regulation.

The provision of the bill to which perhaps most objection is made is that giving the commission power, after a hearing, to determine the rates charged for the services rendered by the public utility corporations, this determined rate thereafter to be the maximum. Power is thus given in extreme fashion to regulate the income of the companies. In connection with the work of the commission, power is given to subpoena witnesses who are com-

used in the same shops showed that the ones worked out in the metric equivalents were more readily understood.

Messrs. Hut and Pernaut were sent over by the French company to inspect the work as it progressed. Their knowledge of English was decidedly limited, and in their talks with department heads and foremen the metric system served as a universal language.

"It was considered cheaper," said Samuel M. Vauclain, superintendent of the works, and a member of the firm, "to educate the men in the metric system than to pay for the loss of time and money which would be caused by converting the drawings.

"As far as the fine calculations were concerned it must be borne in mind that nearly all the work is done by gauges, and that expert measurers are only really required in the gauge department. For many operations it would be a matter of no concern to the workmen whether their gauges were made in accordance with the metric or the English standard.

"I noticed that the men who were using the metric rules formed the idea of a measurement more quickly than they had been in the habit of doing under the English standard. For instance, how does the average man try to find such a measurement as 7 13-16 in. He thinks of the 7 in. first and then forms the idea of halves, fourths, eighths and sixteenths.

"Try to find the dimensions 7 27-32 in. on a foot rule. You reduce the 27-32 to something a little less than ⅞ and you know that it is somewhere between ¾ and that figure. If you take the metric measure, say, of 195 mm., there is no trouble in at once fixing it upon a rule. The fingers seem to go instinctively to the right place on the metric rule. There is no hesitation.

"Much has been said about the fact that the metric system has no exact equivalent for the inch. The inch is generally spoken of as 25 mm., although as a matter of fact it is about 25.4 mm.

"These drawings of the French locomotive that I have before me, for instance, give the diameter of a bolt as 25 mm. Such a thing as an inch bolt is unknown, for the name is nothing more than an arbitrary standard. The bolts used in locomotive construction are tapering. The standard taper which we employ is 1-16 in. to the foot. Thus a bolt 1 ft. in length would be 1 1-16 in. in diameter at top, and 1 3-64 at 9 in. The inch bolt would be an inch only at the threads and it is made to taper so that it can be sent into a hole with driving force. There are always slight fractional variations in practice and the dimension inch as applied to bolts and the like is largely an arbitrary term, as compared with exact measurements."

"How about the contention of certain manufacturers," was asked, "that if the metric system were adopted they would sustain great loss and master dies, templets and the like of great value would have to be destroyed?"

"As far as I can see," answered Mr. Vauclain, "there would be no loss. Templets are continually wearing out and they must be replaced. They are provided with bushings, for that matter, and it does not take much to run a millimeter out of a bushing.

"If the metric system were in use generally in machine shops it would merely be a question of replacing the bushings with those measured in accordance with the metric unit.

"If the metric system were suddenly adopted, say next week, I do not see that it would disturb manufacturers to any appreciable extent. They would simply have to get along with it. In this case we were compelled by circumstances to build these 20 locomotives in accordance with the metric standard, and we did it. The two standards could be used side by side, as they have been while this contract was being executed, and there would be no inconvenience as far as I can see. There certainly has been no trouble here on account of the two systems.

Equipment Appraisals.

The determination of the value of equipment which has seen service is a task which frequently falls to the engineer, regardless of whether he be a specialist along mechanical, civil, electrical or other lines. Just as in preparing estimates the reports of different engineers seldom follow a standard form, a wide latitude for individual judgment exists in connection with appraisals. To a considerable extent, of course, all appraisals are estimates, but in a larger sense they refer to present and past values, while estimates deal more generally with future conditions.

From some points of view an appraisal is merely a matter of spending an hour or so in a plant or industrial establishment and sizing up in a rough way the total present value of the physical equipment. It is often thought undesirable to spend any length of time in set-

[illegible] the value of old equipment from the [illegible] of the second-hand sale of it, for [illegible] is always a pretty heavy shrinkage below [illegible]ginal cost in such cases. Conditions of [illegible] largely determine how much effort [illegible] expended on appraisals, but in gen[illegible] [illegible]e careful appraisal tends to secure a [illegible] price and a sounder decision regarding [illegible] in the equipment than one made in a [illegible] and ill-considered fashion by some in[illegible]d assistant of the consulting engi[illegible] expert auditor who is employed for [illegible].

[illegible] points ought not to be over[illegible] in the making of equipment appraisals [illegible] careful way. The first cost of the [illegible] should be known in detail as far as [illegible], for while the value of the plant in [illegible] few years is bound to be far below the [illegible] investment, as far as redeeming it by [illegible] is concerned, the existence of accurate [illegible] first cost sets ta maximum limit from [illegible] one can safely work downward, basing [illegible] upon the other conditions [illegible] taken into account. Only a wise treat[illegible] the depreciation problem should be [illegible] the main objects sought in handling [illegible] on a broad scale, and the larger [illegible] aggregate of equipment, the more essential [illegible] that individual pieces of machinery [illegible] treated separately in the analysis of [illegible] before adding up the totals of each [illegible] hand valuations are undesirable fea[illegible] of otherwise careful reports. It is not [illegible] purpose of these comments to set values [illegible] depreciation in different kinds of plants; [illegible] is a problem which cannot properly be [illegible] into the limits of a few para[illegible]graphs, though in some reports which have [illegible] presented there is a surprising freedom [illegible] the use of sweeping percentages to cover [illegible] of equipment and heterogenous con[illegible]. At the same time an appraisal which [illegible] to consider depreciation as fully as cir[illegible]ances permit runs grave risk of becom[illegible] little more than typewritten guesswork.

A point often overlooked in the preparation [illegible] appraisals is the approximate cost of re[illegible] worn equipment by apparatus of the [illegible] design. Obviously no set of machines which can be replaced by new and more effi[illegible] outfits at a lower factory cost than that [illegible] the first installation is likely to remain long [illegible] its original service if the operating com[illegible] is alive to its opportunities unless it can be shown clearly that the cost of making the change is too high in proportion to the value of the equipment. These points render an occasional appraisal, say at least once a year, a suggestive piece of work, and they justify not a little care to secure at least approximate prices of the most modern equivalent equipment. It is not uncommon experience to install a new plant equipped at a certain cost with improved apparatus and to find in a few years that the same machines or perhaps improved designs of the first outfit can then be put in at less expense because of the increased demand for their manufacture on a large scale without much subsequent development expense. A sound appraisal must take account of these conditions, if they exist, in order to escape the absurdity of valuing old equipment above new apparatus capable of superseding it. The prospect of early development which shall further reduce the economic efficiency of a plant may be considered incidentally in the appraisement of industrial property, but ordinarily progress not actually available at market prices can be safely neglected in valuing equipment from the owner's standpoint. It is not enough to call in a second-hand machinery man and unquestionably accept his estimate; what is needed is a thorough physical examination of the property with reference to its service, capacity and reliability condition as compared with new apparatus, and its record in the years of its operation. Some of these factors are elusive; others are definite in a well-run establishment, and in their discriminating combination lies the opportunity of the experienced engineer to hand in a financial total for a given installation which represents the best results consistent with the limitation of each personal equation and set of conditions that are brought together.—*Engineering Record.*

Dr. Goss.

It is with the deepest regret that the friends of Purdue University, Lafayette, Ind., have heard of the resignation of Dr. W. F. M. Goss as dean of the School of Engineering and director of the Engineering Laboratory, to become dean of the College of Engineering, University of Illinois, Champaign, Ill.

Dr. Goss was born at Barnstable, Mass., on October 7, 1859, and after the preliminary schooling and a course at the Massachusetts Institute of Technology, he went to Purdue in the fall of 1879. Here he organized the department of Practical Mechanics, of which he has ever since been the head, but his en-

Dr. F. M. Goss.

deavors in late years have been largely along the line of investigations of locomotive performances.

Hence he is widely known in the railway field because of his activities in this direction and his many valuable contributions to the Science of Railway Mechanical Engineering through committee reports, and papers presented before the Master Mechanic and Master Car Builders Associations and various railway clubs. Dr. Goss has been identified with the practical affairs of railways and is recognized as an authority of the highest standing in matters pertaining to the mechanical department.

The collection of experimental apparatus for these investigations and the donation to the Railway Museum at the University are evidences of his ability.

Dr. Goss is a member of The American Society of Mechanical Engineers, and the above named associations, and has recently been chosen by the Carnegie Institute of Washington to carry on special investigation relative to Superheated Steam for Locomotives.

The University of Illinois is indeed fortunate to secure the services of Dr. Goss and we predict great things for that Institution.

It is reported that Prof. C. H. Benjamin of Case School of Applied Science, Cleveland, O., is to succeed Dr. Goss and no better man could be found to take the place.

Prof. Benjamin was born at Patten, Maine, in 1856, and was graduated from the University of Maine with the degree of bachelor of science in 1879. In 1881 he received his M. E. degree. He served as instructor and professor of mechanical engineering at the University of Maine from 1880 to 1886 and from 1886 to 1889 he was mechanical engineer for the McKay Machine Company of Boston. In 1889 he was appointed professor of mechanical engineering at the Case School of Applied Science and has held that position ever since. From 1900 to 1902 he was supervising engineer of the city of Cleveland. He is president of the Cleveland Engineering Co., a member of the American Society of Mechanical Engineers, the author of works on heat and steam, machine design, mechanical laboratory practice, numerous monographs on the transactions of the American Society of Mechanical Engineers. He has made notable investigations of the smoke problem for the city of Cleveland, the bursting of fly wheels and cylinders, stress in pulley arms, strength of gear teeth, friction of steam packing and other subjects.

and declare that their freight yards and slips will be large enough to accommodate all of the traffic that will be offered the company for years to come, and as convenient as the yards of the Southern Pacific or Santa Fe.

At present there are more than 8,000 men employed by the Western Pacific on its road, and more are being added to that number all the time. Subcontractors are arriving every day at Winnemucca and Boca to begin work on their contracts on the line across the "Sagebrush State."

Before the end of the year, the Chilcoot and Spring Garden tunnels will be connected by tracks. It is also determined to proceed with track laying east and west from Winnemucca at once, and rails for the work have been stacked in Nevada and California and many train loads more are on the way.

One of the most peculiar accidents ever known in the history of railway disasters, recently occurred on the main transcontinental line of the Southern Pacific near the city of Gilroy, California. The boiler of a very large passenger locomotive exploded while the train was moving at the speed of about 40

[illegible]

miles an hour. So great was the power of the explosion that the huge boiler was torn completely from the [illegible] massive steel bed and framework of the locomotive [illegible] like a flash, and with a [illegible] the great boiler, weighing many tons, was shot more than [illegible] feet ahead [illegible] squarely on the track.

What was left of the locomotive was in a measure intact, and [illegible] momentum of the heavy passenger [illegible] lowed hard after the boiler and collided heavily with the latter. Literally, it was a case where the locomotive *had a collision with its own boiler!* Both the engineer and fireman were instantly killed — fearfully mangled. There were a great many passengers on the train, but no one was injured. None of the cars—not even the disabled engine—left the track.

Old and experienced railroad men declare that this was the only instance on record where an engine ever came in actual collision with its own boiler.

The Congressional Subways.

BY ARTHUR E. FREEMAN.

THE new office buildings on Capitol Hill, Washington, D. C., located on either side of the Capitol and being erected, at a cost of approximately $8,000,000, for the use of the Senators and Representatives, are to be directly connected to the Capitol building by means of subways—the Senate building connecting to the Senate Wing of the Capitol and the House building to the House Wing.

The work on both buildings is being pushed and rapid progress is being made on their construction, allowing them even now to give a suggestion of the architectural addition that they are to make to the hill.

The excavations for the two subways are now being made and are fairly under way. The subways will have a total length of about 1,200 feet and the cross sectional dimensions are to be 22 feet wide and 11 feet high in the clear. The construction is to be re-enforced concrete, the section of the subway being rectangular. The subways are to contain a sidewalk and also two tracks for the carrying of passengers and freight.

The excavation is to be entirely open cut work requiring no tunnelling and thus enabling the contractors to use the common and [illegible] method of procedure, as is well illustrated by the accompanying picture. Ordinary [illegible] are used and are hoisted out [illegible] by the means of an engine and derrick. [illegible] has been constructed in such [illegible] the wagons drive directly under [illegible] material is allowed to fill [illegible] the chute. This makes [illegible] material much easier and [illegible]

[illegible] is expected in the

Congressional Subway.

locating of the various gas, water and sewer mains that run through the Capitol Grounds, as in some cases, the exact location is unknown. These pipes run up to 30 inches in diameter and the danger lies in the rather treacherous character of the soil and to the sudden and hard rains that strike Washington often during the summer months.

It is intended that both of the subways will be completed by the first of December before the opening of Congress. The work is being done by Chicago contractors for the sum of [illegible].

Steel Box Car.

A. K. READING.

In almost every technical magazine that one picks up at the present time, there will be found some reference to the merits of the all-steel box car. While it is an almost undoubted fact that this type of car will be the one of the future, for many reasons, there are nevertheless, a few objections that should be borne in mind when one considers the question of adopting them.

It is an open point whether or not the all-steel box car will hold the summer heat and so effect the freight carried. Inasmuch as there are a number of steel sheathed elevators out on the prairies, in which the contents rest directly against the metal, it seems as though no trouble would result from this source when small grains are handled. But how about vegetables, large fruit, etc.? Even if the car were of the ventilated type it is doubtful what would occur if a car, loaded with perishable goods were sidetracked during a hot summer day.

Another feature of the steel car which will mitigate against it is the extreme difficulty of securing heavy freight from shifting. Such items as engine beds, fly-wheels, and articles of a like character are usually secured against the pitching of the train by wooden blocks, braces, and cleats, nailed to the floor or sides of the car. It is manifest that this method would not work with steel construction. Some may urge to cut braces, and thus hold a machine by wedging these timbers against the sides.

This does not seem like good practice to the writer, because the essential theory of an all steel box car is that the sides will carry the load acting in the same manner as the ordinary bridge truss. Therefore either the braces or the posts have to be in compression and as the smallest standard sections are easily strong enough to sustain the stress in them, they have not very much resistance to a lateral thrust. So if a heavy piece of freight were braced by timbers to the sides and the sway of the car caused the brace to bend a post already in compression, the latter's value as a column would be immediately destroyed and the unity of the side truss impaired. An interior floor and lining of wood, of course, will overcome both the first objection and this one, but in that case what is gained over the steel underframe box car.

A third argument against the all-steel car is the difficulty of repairs. This is a point that will be immediately replied to by the remark that such a difficulty was not experienced to any large extent with steel gondolas and flats. But in the case of the box car conditions are vastly different. In the first place the side truss construction is so efficient that the lightest of sections and plates easily carry the load. The roof and sides are made of No. 10 to No. 12 gauge steel. The side doors are of very small angles and T's. Very few of the western division shops, or in fact any moderate sized division point, carry this small stock. Suppose a car lost a side door in transit. How would it be replaced? If several roof sheets become punctured in some

manner the car would be out of commission for handling freight that water would effect, until the car could reach a properly equipped repair shop.

A fourth point is the question of increased patent royalties. As soon as the all-steel car is demonstrated to be at all feasible, the various car builders throughout the country will take out patents upon every conceivable type of construction. It will be absolutely impossible to purchase a steel box car without paying a royalty on practically every part in it or method of construction, from nut-locks to side door. This may not be apparent to the casual purchaser but it is a vital point to those who have experienced trouble along that line.

While the foregoing is detrimental to the all-steel box car there are a great many reasons why it should be a success and the writer thoroughly believes in it, yet at the same time believes that its disadvantages should not be lost sight of as has been done so many times in the articles written about it, for while from the engineering standpoint, it is perfect, yet looking at it from the view of the freight and operating department it is a questionable proposition.

A Coal Stripper.

THE illustrations show a specially designed stripping excavator built by the Bellefontaine Foundry & Machine Co. of Bellefontaine, Ohio, and furnished to G. W. Prutzman, Danville, Ill., who has a contract with the Consumers Coal Company of that place, to strip thirty-five acres of coal lands. Briefly, the proposition in hand is to remove from thirty-eight to forty feet of overburden, sixteen to twenty-four feet being shale and the balance gravel and clay at a single cut, placing all the material to one side, leaving a bottom width of thirty-six feet of clean coal ready for removal. To meet these requirements and to remove so great a depth and material of such a nature economically, the largest shovels with engines and cars could not keep the cost down to the limitations imposed, and a long boom machine sometimes used in similar but more shallow work with varying and uncertain results and at best slow in action, was not to be considered at all.

The following three points were considered by the designer as essential to be met:

First, that the strictly excavator portion of the machine should have a speed of operation equal to the largest steam shovel with ample power.

Second, that to obtain the great disposition of the material required a second handling of about eighty per cent of all the material and that this delivery should be continuous and practically automatic and require no labor in addition to that required about an ordinary steam shovel.

Third, that the reach or radius of action on the excavator proper should be sufficient without sacrificing speed to enable the operator to cast all large boulders, stones, logs, trees, etc., directly into the pit when the coal had been removed.

A glance at the work this machine is doing will show how fully the points above have been met, and in meeting them a machine has been produced that will handle material at the lowest possible cost.

The following description of the machine, general construction and operation will be of interest to those who have large earth handling propositions confronting them:

The car d ·k or platform proper is thirty feet wide by fifty-six feet long, mounted on four special trucks moving on two tracks, the tracks composed of the usual short heavy sections of rails laid loose on the ties and tramed with bridle bars. The forward trucks are at the immediate front end, while the rear ones are set under some eight feet from the rear. To allow for inequality of the coal surface on which the tracks are laid, the trucks have each, one swivel axle so that the load while equal on each wheel is carried on three points. The truck bodies proper are built solid of heavy beams, and the wheels are thirty inches in diameter and weigh nine hundred pounds each, having double flanges two and one-quarter inches thick and are amply strong to crowd the rails of the two tracks into proper relation to each other. When making short curves one or two of the rails are laid directly on the ties and the other on steel plates on the ties. Unusually large bolster plates bear into bolster plate sockets in the trucks, there being no attachments of any kind otherwise, so that the trucks can be swiveled short enough to turn the entire machine at right angles in less than twice its length if desired. To give the entire car body a three-point suspension on the four trucks the rear portion of the car is carried on a

one hundred and five feet center to center, which is supported on tower forty-eight feet high above the deck. This tower is located crosswise of car body and just back of the "A" frame. The dumping clearance at outer end of conveyór is nearly sixty feet above the track. In the ordinary operation of the machine with the twenty-four foot handle, all very large or heavy pieces, stumps and logs, are easily cast into the space, from which the coal has been removed, direct from the dipper. Two jacks, one on either side directly under the elevator tower and directly attached to car body proper without an overhanging arm and resting on the track just back of the front trucks, prevents oscillation of the elevator or car to any extent whatever when the

This machine has been fully and thoroughly tested in what is considered the heaviest and roughing and stripping proposition for coal ever attempted. The company is prepared to build two sizes, the two yard illustrated for very hard and deep material and the one and one-quarter yard size for work not so deep or heavy. The length of the conveyor arm of course is varied on either size to suit the depth of material to be handled, but it will be understood that the length of the elevator has nothing to do with the excavator speed or amount of material that can be handled whatever. While primarily designed for stripping large coal beds or veins, there are many large earth handling or moving operations to which such a machine could be very profitably applied.

Front view of stripper showing spoil pile.

machine is in operation. The usual propeling mechanism is discarded and this machine is easiy moved in either direction by steel rope tackles hooked directly into the back of the dipper. Special forged track grabs which seize the rails just back of the forward trucks serve as proper hitches or anchors. Changing forward and rear blocks from truck to track or vice versa reverses the direction of the car when pulling at the dipper. This is an extremely powerful mode of moving the car and at the same time leaves the trucks free to swivel any amount desired and eliminates chains and sprockets, clutches, etc.

Personal.

Mr. J. Heiskell Weatherford has been elected city engineer of Memphis, Tenn. Term of office was fixed from Aug. 1 to Feb. 1 at a salary of $250.00 per month or $3,000.00 annually.

Mr. M. B. Palmer of Rome, N. Y., is to head the engineering corps which will survey the site for the new high service distributing reservoir for city water for Syracuse, N. Y

The staff consists of eight men

Domestic Industrial Notes.

East Syracuse, N. Y., has been asked to pay $80.00 per lamp per year on a three year lighting contract. A price had been submitted to the individual consumers of 12c. per kilowatt, less 2c. per kilowatt on bills paid before the 5th of each month.

Dredging interests of the Atlantic, Pacific, Gulf and Great Lakes, representing in the aggregate $30,000,000 of capital, met in conference in Buffalo to devise means to procure legislation in Congress to prevent government construction of dredges. The dredge men claim the tendency of the government in this direction points to an ultimate destruction of the dredging business. The next session of Congress will be appealed to.

All record of the United States Steel corporation in the manufacture of steel were shown to have been broken when the company's report for the quarter ended June 30 was made public after a meeting of the board of directors.

The report shows that the company's total net earnings for the spring quarter were $45,503,705, a high water mark record for any single quarter in the company's history. This record breaking total is an increase of $5,378,[illegible] over the corresponding quarter last year. The amount of unfilled business on hand June 30 was 7,603,878 tons, an increase of 794,289 tons over last year.

The statement also shows that $18,500,000 was set aside after all charges, interests and dividends were paid, for new plants, additional property and constructions. This is an increase of $5,500,000 as compared with the appropriation for the same purposes for the quarter ended June 30, 1906.

It is predicted that steam from the earth will furnish power for tomorrow. It has been proved that the heat increases as one goes toward the interior. The temperature at the bottom of a certain well in Pittsburg is 129 degrees. Suppose two holes were bored in the earth, 12,000 feet deep and 150 feet apart. The temperature at the bottom would be 240 degrees, or far above the boiling point of water. If heavy charges of dynamite were lowered to the bottom of each hole and exploded, and the process repeated several times, a connection between the two holes could be established. Water turned into one hole would, in the opinion of some scientists, be turned into steam which would come up from the other hole.

It is said that such an enterprise could be started at Pittsburg, for instance, at an expense of $50,000, and yield a profit on the investment. The Yellowstone Valley would probably be the most favorable place for the experiment, but is too far from manufacturing center.

Of the one million immigrants that annually come to this country perhaps no other section receives as great a proportion as the Pittsburg district. In this place the many mills, mines and factories create a demand for unskilled labor which is never fully supplied. During the months of May and June between 3,000 and 3,500 men were brought to Pittsburg by the U. S. Steel Corporation. These aliens were principally Magyars, Slavs and Roumainians, and were sent to this city by agents of the steel corporation, who watch the influx of foreigners.

While there is so great a demand for unskilled labor that the various corporations' agents meet with much competition to supply the demands of their principals, still there is no claim that the immigration laws are being violated. The Pittsburg labor market was depleted before any of the industrial managers began to send agents to Ellis island, and if the present plans of the steel corporation are carried out, it will be three years before the extensive improvements and alterations now planned are completed. But all of these foreigners do not remain in this country. Many of them hoard their earnings and return to their native land to spend the rest of their days in idleness and ease.

The company having the concession for the construction of a railway from the station at Kansk, Siberia, to Behring Straits, and the construction of a submarine tunnel under the Straits to the American Continent, the resolution of the Council of Ministers for which has just been ratified by the Czar, is an American corporation.

It was organized in New Jersey last October for the purpose of constructing this railway. It is announced that the railway will be 3,750 miles long, exclusive of 3,000 miles for proposed branches.

The actual tunnel under Behring Straits from Northeast Cape to Cook's Inlet, in Alaska, will be thirty-eight miles in length.

The total cost of the project is estimated at about $500,000,000.

The scheme was originally put forward by M. Loicq de Lobel on behalf of an American syndicate with which a man named Addicks is said to be connected.

Doubts are expressed here in view of the fact that the British Government and people opposed so bitterly the recent agitation for a tunnel under the channel between France and England as to whether the American people would ever consent to the tunnel to Alaska.

The tunnel under the channel from France to England last spring failed to meet with popular approval because the military strategists of England and France were opposed to it, though it was regarded at the time as a project more feasible from the point of view of the engineer and the financier than the tunnel now proposed under Behring Strait.

The Engineering Experiment Station of the University of Illinois has just issued Bulletin No. 11, "The Effect of Scale on the Transmission of Heat through Locomotive Boiler Tubes" by Edward C. Schmidt, M. E., and John M. Snodgrass, B. S. This bulletin describes a series of experiments begun in 1900 by the railway engineering department of the University of Illinois to determine the relation of the heat loss due to scale to the scale thickness. The experiments comprise tests on single tubes as well as tests of the entire locomotive boiler.

The results of all the tests, plotted with reference to scale thickness, show great divergence in the heat loss, which is ascribed to differences in scale structure. The bulletin is of interest to all who have to do with the operation of steam boilers in localities where pure feed water is not available. The conclusions derived from the tests are summarized as follows:

1. That for scale of thicknesses up to ⅛ inch, the heat loss may vary in individual cases from insignificant amounts to as much as 10 or 12 per cent.

2. That the heat loss does increase with thickness in an undetermined ratio.

3. That mechanical structure of the scale is of as much or more importance than thickness in producing this loss.

4. That chemical composition, except in so far as it affects the structure of the scale, has no direct influence on heat transmission.

There has been so much said about the General Electric Company of Schenectady building a big plant at Erie, Pa., that a word in explanation of the situation may satisfy Buffalonians who have cherished hopes that the company will locate its plant there.

The General Electric Company has made its plans for locating a big plant at Erie. These plans call for a series of buildings greater than anything existing in that part of the country. They also provide for an experimental yard containing forty tracks. The freight business of the company will average about 400 cars a day. The plant will be second in size only to the Schenectady works, and will employ between 7,000 and 8,000 skilled laborers.

There is a stumbling block in the way, and that is the application of a Belt Line road for the condemnation of the south end of the property purchased by the General Electric, which strenuously objects to parting with this land. The Belt Line is composed of Erie capitalists, and thus it is that citizens of Erie themselves are standing in the way of the city getting the biggest industry in that section of the country.

In this connection the Erie Dispatch says: "That the General Electric Company will not meekly submit to be 'held up' in all its shipping facilities by a one road switch goes without saying. No manufacturer connected with the proposed Belt Line would submit to it in his own business. And if the General Electric should fail to break this proposition and determine to locate elsewhere, the known projectors of the proposed Belt Line, as individuals, will have to stand the odium of responsibility."

The most powerful locomotive ever built has been brought out of the Westinghouse Electric & Mfg. Co., of Pittsburg. This new traction Goliath is an electric engine which develops 4,000 horsepower. The electric locomotives adopted by the New York Central Railroad have a maximum pulling capacity of 2,200 horsepower; the new steam locomotives which haul freight trains over the steep grades of the Rocky mountains, and which hold the horsepower record for steam locomotives have a maximum capacity of 2,000 horsepower, while most of the fast passenger locomotives do not go over 1,600 or 1,800 horsepower.

The commercial prize which has stimulated

shifted as to cause both cylinders to operate as a gas engine. We supply two tanks, either one of which will start the engine half a dozen times. In very large plants where it is desired, a small engine may be used to drive the air compressor, in which case only one tank would be used. Also, where two engines are used to drive dynamos, we install a small motor to operate the air compressor, in which case the air compressor can be operated while either engine is running."

Foreign Industrial Notes.

The Harbor Board of Skein and Porsgrund, Norway, propose the expenditure of over $100,-000 for deepening and widening the river to make Skein accessible for much larger vessels.

Consul-General W. D. Straight makes the following report from Mukden:

One of the principal exports of Manchuria is bean oil, whose use at the present time is largely for illuminating and cooking purposes. The manager of the Mitsui Bussan Kaisha at Tieling, however, believes that by combining it with a small percentage of some other oil it will be possible to produce a very satisfactory and cheap lubricant, and states that his company is at present performing experiments to that end.

Consul Gebhard Willrich reports that contracts have been made for the extension of wharves at St. John, New Brunswick. These total 800 feet, and are to be completed by next winter. Other new wharves are in contemplation, one of which will be 650 feet and the other 400 feet in length. The names of contractors for harbor works and divers at St. John are filed for reference at the Bureau of Manufactures. The consul also forwards a copy of a special report of the St. John Board of Trade on future improvements to be made at that port, together with a map of the harbor. These will be loaned to persons interested in the export trade.

The construction of the Philippine railroad system which is to connect Manila with Cavite, Batangas, and Lucena, tapping the rich plantations of the southern end of Luzon and which will mean so much to the still further development of that section of the country, has now taken definite and material form, says the China Telegraph. It is the intention of the Manila Railroad Company to follow the present Antipolo line from Tondo as far as Santa Mesa, laying another track and enlarging the depot or station there, and to carry the double track then to Pandacan and Paco, where there will be another station, whence will start the main line which later branches out for Cavite, Batangas, and Lucena.

A syndicate with a capital of several million pounds has been formed for the purpose of sinking coal mines in Nottingham and several adjoining counties. An eminent expert believes that the proven ground is a mere fraction of the collective coal area in the Midlands. Coal is being profitably worked at a depth of over 3,000 feet. Several new coal seams have just been struck in this county. The export demand for coal has recently been so great that railways and British seaports have been literally choked with it.

According to statements made by British lumber dealers, the relatively small quantity of lumber imported from the United States to these parts is mainly due to the indifference and inattention of the American sellers. I am told that orders are not filled promptly, sometimes only partially, sometimes not at all, even when accepted. According to these statements, the usual excuse, if one be offered, is that the press of home orders prevented attention to the export trade. After a few experiences of this kind, the British importer says, he gives up attempting to deal with the United States.

Consul Frederick Van Dyne, of Kingston, sends the following information concerning the proposed grant and loan for the rebuilding of Jamaica:

With regard to a loan, the British Government intends to give the colonial government the option of borrowing $3,873,000, to be secured by the revenues of Jamaica, for rebuilding Kingston. The loan is to extend for six or seven years. In addition to this loan the British Government has consented to donate $730,000, and besides, the people of England subscribed $243,000, which would make a total of $4,866,000 available for relief. Of this amount, $973,000 is to be distributed for the relief of persons who were left destitute by the earthquake. While Parliament has yet to pass upon the loan proposition, there seems to be no doubt that it will be adopted.

end of a cord. Wherever electricity is introduced these are generally superseded by electric ceiling fans.

The natural field for the hot-air engine fan would be in localities where there is no electric power, but it has been found that it can compete with the electric fan in the latter's own field, owing to the extreme cheapness of the cost of its running, which is about one-fifth of that of the electric fan.

The fan is propelled by a hot-air engine, the heat being generated by a kerosene lamp which holds about 1 quart of oil, sufficient to keep the fan running for over twenty-four hours. To the lamp is attached a small glass chimney which fits into a larger metal chimney connected with the engine. Upon the top of the engine is hung the fan, similar in shape and size to the ordinary electric fan, whose speed is governed by the size of the flame; that is, to reduce the speed the flame is turned down, and to increase it the flame is turned up. The whole outfit weighs about 30 pounds, and sets upon a small stand, raising the level of the fan proper to that of an ordinary desk. It is fitted with handles, and can be easily moved to any part of the room or house desired.

If American manufacturers can produce a similar article, with perhaps a few improvements and at a smaller cost, an immense field will be found for its sale, for this is not necessarily limited to India, but would include every hot country in which white people are compelled to live.

These fans at present sell for $62 each, which makes them rather too expensive to be used by any but the well to do. However, the manufacturer expects to soon be able to materially reduce this price with the expected larger output.

Senor Pedro Puigjaner, a well-known engineer of Barcelona, Spain, has invented and submitted to practical trials a rotative steam engine which it is asserted will cause a revolution in all countries where steam power is used. It is claimed for this remarkable engine that it may be applied to all purposes for which steam power is required, whether on land or on sea, and that it consumes but one-fifth the coal per horsepower that ordinary engines consume. For example, it is declared that a ship burning 500 tons of coal per day with the ordinary marine engine would burn but 100 tons with the new invention. It is also claimed that the small relative size of the engine is a great advantage, since it occupies but one-fifth the space occupied by an ordinary marine engine. This also applies to bunker space, but not to the boilers, which are of the usual dimensions.

The inventor says that even when it is a question of motive power of trifling importance, the consumption of coal by his rotative engine is confined to half a kilo (1.1 pounds) per hour per horsepower, and does not go beyond this established maximum, which decreases to an appreciable extent when a machine of 100 h. p. is required, and so on successively until the expense of fuel does not exceed a quarter of a kilo (0.55 pound) when the engine is working at 1,000 h. p.

Another claim for the engine is its weight. The ordinary 100 h. p. engine, for example, weighs 15 tons; this one but 3 tons. The inventor also says that the engine being much smaller, the cost of production will also be much less, and it can therefore be sold considerably below the prices of ordinary engines of the same capacity. It is claimed that the economical results thus indicated are not exaggerated, when it is considered that the machine combines all the essential and efficient working capacities of the ordinary steam engines in use at the present day in which the piston with rectilinear motion is employed, including, consequently, those which are the properties of the most improved turbines moved by steam. The inventor has protected his engine invention by patent in Spain and elsewhere and has applied for patent rights in the United States. [A plan drawing of the engine is forwarded by the consul-general and is on file with the Bureau of Manufactures, Washington, D. C.].

Count Arco, in his wireless telephone experiments, says that he has succeeded in obtaining distinct exchanges of words in a tolerably natural voice, at a distance of two miles, by using poles thirty feet high.

Rear Admiral Manney, who was a delegate of the United States to the international conference on wireless telegraphy at Berlin, and Lieutenant Commander Howard, U. S. N., the American naval attache here, have been present at a series of private exhibitions of the wireless telephone apparatus and have been able to talk with each other at a distance somewhat less than three miles. But the best practical results are attained at two miles or under, with thirty-foot poles.

Electric Steel.

SMELTING METHOD IN GERMANY—CARRYING OUT FRENCH INVENTION.

MANY American inquiries having been made on the subject of electric smelting of iron and steel, the following technical report from Consul G. E. Eager, of Barmen, will furnish valuable information as to the German process:

During the entertainment given to the visiting society of American engineers by their German colleagues at Dusseldorf on the Rhine, in August, a visit was made to the electric-steel works of Richard Lindenberg, at Remscheid Haston, Rhenish Prussia, to witness the production of steel after the new patent electric process, the invention of Dr. Engineer Paul Heroult, France. During the past several years technical literature of many countries has has teemed with extensive reports regarding smelting processes by electricity, but few, if any, of these have been put into successful operation. The Iron Age recently contained an article on electric smelting for pig iron, but said nothing of the feasibility or economy of producing steel by this process.

On arrival at the Lindenberg Works surprise was expressed by the visitors to find that under this new process the production of the highest grade steel had been in successful operation continuously night and day since February, 1906, and that after a sufficient trial of the new process the old crucible methods formerly employed had been entirely discontinued.

MAKING THE NEW STEEL.

This plant produces almost exclusively high-grade and alloy steel, for which there is a great demand by the immense skate, cutlery and tool manufactories in this district, of which industries those at Remscheid and Solingen are the most important in Germany, and the demand for the new steel has been so great that an enlargement of the plant is being made to increase the output. Up to the present time high-quality steel has been produced by a smelting process in graphite crucibles with a capacity of only 65 to 110 pounds, and as the necessary raw material had to be imported from Sweden or Steiermark, the expense was very great, costing from 80 marks ($19.04) to 350 37.80 marks ($9) to 100 marks ($24) a ton.

At the Lindenberg electric works high-grade steel is produced from the most ordinary scrap-iron rubbish of the cheapest kind and quality, and its condition is quite immaterial, as by the process all damaging substances, such as sulphur and phosphor, are practically eliminated, being reduced to one one-hundredth of 1 per cent. The cost of this scrap iron varies from 45 marks ($10.71) to 60 marks ($14.28) for 1,000 kilos (2,200 pounds), and the loss of material in slag and refuse varies between 6 and 8 per cent.

This rubbish is first melted in a tilting furnace or oven, constructed similarly to those ordinarily used in our American smelting works. After being thoroughly reduced to a fluid state it is poured and conveyed in a retort by a traveling crane to the Heroult patent electric oven, which has a capacity from 1½ to 2 tons. In this oven the necessary quantities of carbon, manganese, chrome, silicum, nickel, tungstate, arsenical iron, etc., are added, to produce any kind or quality of steel desired. The whole process of production takes from 2 to 2½ hours.

OPERATION OF ELECTRODES.

The developing bath is heated by an electric current of 100-volt tension, which is brought into connection with the oven by means of a coal electrode and carried back to the current by a second coal electrode, both of these electrodes being suspended perpendicularly through the top of the oven, and adjustable so as to nearly, but not quite, come in contact with the melted mass. The current leaps from the electrode in a wide, mighty voltaic arc, and passes through the mass to the second electrode, thus producing the requisite degree of heat sufficient for the purifying and finishing process.

The casting molds for the electric steel are the same as are used in any other factory. The cost of production depends upon many points which will become clearer after further experience with the new process. Raw material, fuel, electric current, wages, etc., depend largely upon the locality, etc., and the improvements in the process that may be made make it difficult to quote reliable figures, but it is safe to say that an average quality of steel, as heretofore produced by the crucible process, can be made by the electric process from 90.66 marks ($23) to 100 marks ($24) per ton.

FURTHER ECONOMY POSSIBLE.

We were assured by Mr. Lindenberg that a great saving could be made by having ovens of 10-tons capacity. The consumption of electric current in the present 2-ton furnace

Pennsylvania Railroad Gravity Yards at Bedford, Ohio.

THE Pennsylvania Company's new gravity yard at Bedford, Ohio, will accommodate 772 cars. It will have 16 tracks and will be 3,000 feet long. The work on it was started April 1st, 1907, and it is expected that it will be complete by December 1st of this year. E. H. France Sons have the grading contract. There are 350,000 yds. of dirt to move.

The equipment consists of three steam shovels, Marion Model "60" with 2½-yard dipper, five 12-ton and two 18-ton Parker locomotives, and 28 Kilbourne and Jacobs and 60 Western dump cars.

The cut runs from six to twenty feet in sticky clay. The shovels are located from ½ to ¾ of a mile from the waste pit in which the dirt is dumped. From 15 to 20 cars are hauled per yard. The shovels are averaging 1500-1800 yards per shovel per day. Henry Beinecke, engineer for one of the shovels, made a good run between the 20th of June and the 20th of July; during that time he took out 38,000 yards. On the 16th of July he loaded 632 four yard cars or 2,528 cu. yds. for the day. Four men are used in the shovel pit

The gravity yard is planned to have a 1 per cent grade to assist in classifying the cars. A scale will be located at the head end of the yard and from this for a short distance there will be a 3 per cent grade to give the cars a start.

Waste pit where dirt is being dumped. Pennsylvania Railroad Yards, Bedford, Ohio.

A Registering Conveyor.

THE accompanying illustration shows a Spencer registering conveyor loading sacks of flour into the Great Northern Steamship "Minnesota" at Seattle, Washington. These machines are reversible, and are equipped with electric starting and stopping gear which may be operated from either end of the machine. Extensions may be attached to the lower or the upper end of the conveyor by means of steel sprockets and chain to permit goods to be taken from a warehouse and elevated to the deck of a vessel and carried across the deck to the hatchway.

The conveyor is portable, mounting on roller bearing truck wheels. It conveys up or down at any angle, and the endless carrier can be regulated at any speed desired, from 50 to 175 feet per minute, by simply touching a lever. An electric push button is provided at the top end of the conveyor to stop the machine instantly if necessary.

The traveling apron rests on a steel, anti-friction roller bearing rollers, set two inches apart on both sides of the conveyor. It will convey and register from 3,000 to 5,000 sacks, cases, barrels, bundles, etc., per hour, according to the size and weight of the objects to be conveyed.

Loading sacks of flour onto the Great Northern Steamer "Minnesota" at Seattle

The makers claim that the conveyor will pay for itself in a few months by saving time and by increasing the volume of freight handled. It dispenses with all of the checkers and part of the truck men. The conveyors are supplied in length of from 20 to 50 feet, with back geared motors to suit the electric current used at the loading point, or with gasoline motors.

These machines are made by the Spence Mfg. Co. of St. Paul, Minn. They installed two of them during August for the Western Transit Company at Buffalo, N. Y.

The Improved Oliver 12-Yard Dump Car.

THE expenditure of vast sums of money in the reduction of grades and eliminating the curves on our own railroads as well as the large amount of new construction work in the building of new lines, has resulted in the brightest minds in the engineering and contracting field producing or attempting to produce appliances by the use of which the cost of said heavy construction work can be greatly reduced.

The most notable steps forward in this direction during the past four or five years has been the evolution in the construction and especially in the size of the implements used in excavation work. This applies to the building of steam shovels, which have been increased in weight and size of dippers from 35 ton to 100 and 110 ton steam shovels and in capacity of their dippers from ¾ yard up to as high as 5 yard capacity, and to keep step with these great changes in the steam shovel field, it has been necessary to provide cars large enough and strong enough in which to load earth and rock, in order not only to have a car which would stand the extra weight and strain, but also enable the contractor and the railroads to move the earth economically by keeping said enormous steam shovels constantly in operation.

One of the most notable improvements in this direction during the past few years is shown on the accompanying page marked Figures 1 and 2. These illustrations are reproductions from real photographs taken of cars built at the works of the William J. Oliver Manufacturing Company, of Knoxville, Tennessee, and show his improved 12 cu. yd. capacity two-way dump car. This car has been used in all parts of the country by the leading contractors, and has always given excellent satisfaction. The description of this car is as follows:—

Weight 2800 lb., and the wheels 33". This car is of special interest because it is designed and built by Mr. William J. Oliver, one of the largest contractors in America. His many years of experience in the handling of all kinds of material should have, and evidently have, enabled him to produce a car which is not only a money saving appliance

Fig. 1—Car in normal position.

[illegible] the moving of earth and rock in large [illegible], but is also practical in all the details of its construction. As will be noted by the specifications, the car throughout is built [illegible] the standard specifications of the M. C. Association, the wheels being 33" in dia., and the trucks of all steel construction. The [illegible] is built with either wooden or steel sills; reinforced by 4 x 6 x 3/8 channels on the [illegible] side of the box, and this in turn is reinforced by heavy truss rods on the under [illegible] of the body of the car, and also on each [illegible] of the doors.

It will be noted in cut as having two truss [illegible] to each door. Mr. P. T. Walsh, of Davenport, Ia., has recently placed a large number of these cars on his work, and did [illegible] after making a careful investigation of all the different large cars on the market, and spent considerable time in going to different points to see the cars in actual service. [illegible] of the cars (the same as is shown in [illegible]) is now on exhibition at the Jamestown Exposition at Richmond, Va.

The adjustment is so perfect that one man can pull this enormous 12 cu. yd. car back into position after the car is dumped, and the writer has seen this practically demonstrated at Mr Oliver's works. Our representative found on a personal visit to the works of the William J Oliver Manufacturing Company at Knoxville, that they were very busy in all departments, having orders ahead for enough cars to run their works for several months. Their plant occupies about 35 acres and their main shop is 400' long by 100' wide. They also build at this plant a spreader car and dump cars in all sizes from 1 to 20 cu. yds. and of any gauge that customers desire.

Mr. Oliver informs us that he is now constructing a dump car of 20 cu. yds. capacity, which he expects shortly to put on the market.

Figure 1 showing 12 cu. yd. car in normal position. Fig. 2 showing 12 yd. car dumped with one man pulling it back into position.

Development of the Chain Drive.

IT is a matter of interest to note the development of the Chain Drive. Chain drives of the past have passed through sprockets with outward projecting teeth. This, of course, necessitates depressions or perforations in each link in order to accommodate the teeth of the sprocket.

The Clouser high speed chain belt made by the Link Chain Belt Co., 52 Dey St., New York City, is so designed as to obviate the difficulties of the old methods as follows:

Where the teeth of the sprocket must project into or through the link, it follows that

Fig. 2—Showing dumping position.

the link must be made correspondingly wide and heavy so as to make up for the lack of material made necessary by the opening. In the Clouser belt the teeth or the knuckles as they are called, are on each link while the sprocket contains depressions which receive the tooth of the link. It is thus possible to have a much narrower link in a chain without weakening its strength in the least. It is shown by catalogs of the company that a half inch chain is equal in strength to the old No. 42 style made by other methods and the one inch Clouser chain is equal in strength to the old style No. 83.

It will be noticed that the teeth or knuckles engage the depressions in the sprocket in the same manner as the tooth of a pinion gear, i. e., rolling contact exists and not sliding contact.

The cut shows the flanges with which the sprocket wheels are cast and which guide the chain into place so that the tooth on the bottom of each link engages accurately with the corresponding depression in the run of the sprocket wheel.

Another admirable feature of this chain is that it can be run as a cross belt upon centers distant 4 ft. and over, by means of the simple experiment of reversing every other link. This change can be made in a very few minutes by an inexperienced workman for the reason that there are no pins, bolts or rivets in the entire make-up of the chain, there being but as many parts as there are links.

The construction, since it omits pins and rivets, is such as to render it self-cleaning, for through its entire operation dirt is thrown out from the wearing portions and not allowed to accumulate to the injury of the chain.

The Clouser chain has been operated on sprockets revolving as high as 950 R. P. M. and has also been operated at a ½ turn within 18 ft. centers; also as a direct drive on motors within 17" centers. These chains are made in sizes from ½" up to 2" in width and can be applied to all kinds of power transmission work such as driving counter shafts; concrete mixers; elevators, rock crushers, and machinery for handling coal, coke, cement, ores, sand and any other various propositions where power is to be transmitted.

Pittsburg is awakening to the necessity of more forests to protect her valuable interests from injury by floods. Other communities are in the same boat. The watersheds of the Allegheny and Monongahela rivers cover nearly 22,000 square miles. It is estimated that 2,000,000,000 trees would be required to suitably plant the denuded territory, and that fifteen years must elapse before they would be of any material benefit. Also that the expenditure would be enormous.

Admitting all these drawbacks it would be a paying investment. The Pittsburg district lost $15,000,000 by the single flood of last March. Other districts lost in proportion. Floods are so common nowadays that they are apt to visit us at least once a year. In much less than fifteen years would the damage be equal to the sum expended for replacing the territory which was once forests—or at least a sufficient portion of it to provide protection.

Cement Company Buys Land.

From the western papers it appears that the North American Portland Cement Company, through A. F. Gerstell, vice president and one of its directors, has just bought some four hundred acres of valuable cement land at Bellevue, Michigan, where rock material of the best quality has been discovered. At the same point is located the plant of the Burt Portland Cement Company which has been making Portland cement by the dry process for some time. It is expected that very shortly extensive works with a capacity of some 3,000 barrels a day will be erected upon the new site by the North American Company, which will prove a formidable competitor for business in the middle west.

Strategically, the location of the new plant is an important one due to its proximity to Chicago, to which point it has very low freight rates. In addition to this, its geographical situation will enable the new plant to ship, upon extremely favorable rates, cement to points in the middle west where the demand has for some time out-stripped the available supply.

Department of Industrial Betterment.

Edited by Warwick S. Carpenter.

[This department is devoted to those matters which tend to increase the efficiency, comfort, health and self-respect of employees. It will cover such matters as Industrial Hygiene, Industrial Housing, Industrial Education and others which come under the general head of Welfare Work or Betterment. The readers of The Industrial Magazine are asked to co-operate in making the department a success. Pertinent and valuable suggestions will be published each month. Communications should be addressed to "Department of Industrial Betterment, The Industrial Magazine, Park Row, New York.]

The Welfare Work of the Y. M. C. A.

AT the dedication of the Westinghouse Air Brake Company's Welfare Work Building at Wilmerding on July 20th, Mr. Henry G. Prout, First Vice-President and General Manager of the Union Switch and Signal Company, brought out a vital point in such undertakings.

"It is an easy thing to build and equip welfare buildings," he said, "but it is a hard thing to have them profitably used. It is a famous fact in natural history that you can lead a horse to water, but you can't make him drink. The human animal, as observed in America, is much like the horse in this particular. Possibly we might even compare him with a certain humble relative of the horse. He is quite willing to drink in his own way, but he does not like to be bossed in his personal affairs. It is a matter of common experience that those benefit and welfare undertakings which thrive best and do most good are those in which the beneficiaries take an important part in the management and maintenance. The serious question of management that the directors faced was how to arrange matters so that those who were to make the most use of the facilities provided should have a part in their support and administration. Fortunately, the Young Men's and Young Women's Christian Associations seem to provide the requisite organization and methods, and the board has arranged to entrust the responsibility of running the buildings to those organizations. It is believed that this arrangement will make the feeling of personal interest and personal responsibility on the part of those who are actually to use the building as close as it is practicable to make it and still keep up an efficient working organization with a positive and continuous policy."

The Y. M. C. A.'s work at Wilmerding is typical of what it is undertaking on a large scale throughout the country. Through its Industrial Committee, the Association is conducting a movement among employed men to establish Associations in their communities, or to have some work inaugurated by and for these employed men in the places where they work, with the assistance of the already organized city Associations.

The general plan which is being followed is:

First. To make a careful study of the conditions which surround men in industrial pursuits, and to make investigations of individual factories, mining towns, lumber camps, etc., when desired.

Second. To make a careful study of all forms of work which have been attempted, in order to correlate the experience of all.

Third. To co-operate with the workingmen and the companies in furthering the plans of the men themselves for their own welfare, by enlisting them in lines of activity in order that they may be the chief means of their own betterment.

Fourth. To organize shop Bible classes, educational classes in factories, branches of the Young Men's Christian Association, and other work adapted to the specific needs of the various communities where employed men toil and live.

Fifth. To co-operate in all forms of welfare and betterment work, whether a part of the Young Men's Christian Association or not, in order that the best possible conditions may be brought about in these industrial communities.

The movement is still young, but its success seems to be already assured. Already there are flourishing Associations among the quarrymen of Vermont, the Pennsylvania Coal Miners, the textile operatives at North Adams, Mass., and at Monaghan Mills, Greenville, South Carolina, at the National Tube Works of Lorain, Ohio, in the lumber camps of the Pearl River Lumber Co. in Mississippi, and in many other places all over the United States.

contain coffee or milk, soup, hot meat, vegetables, bread and butter and dessert The plan has met with the endorsement of a number of factories and has been started in those of Isaac A. Sheppard & Co., and H. W. Butterworth Sons Co., and at the shops of the Philadelphia and Reading Railroad.

It is because Kensington possesses so many of the elements of all other manufacturing communities rolled into one, that the work there has been instituted on so large a scale. It is receiving the co-operation of the International Committee of the Y. M. C. A., and in the light of the results there achieved it will be extended to other fields.

The general subject of welfare work and even of that particular part of it, which is called Industrial Education, is so broad that it can not be fully covered at one time in the space available for this department. It is our intention in a later issue to run a symposium of the subject on industrial education and to follow with others on different departments of welfare work. The men who will contribute to this symposium will be among the most successful employers and General Works Managers who have had opportunity to observe the different plans in their actual operation.

New Postal Regulations.

A new postal card regulation went into effect August 1st, 1907, by which one-third of the face of address side may be used for correspondence, provided it is separated from the address by a vertical line. Furthermore a thin piece of paper may be attached, bearing writing or printing or both. Advertisements or illustrations of writing may appear on the back of the cards, and on the left third of the front.

The Art of Cutting Metals.

"The Art of Cutting Metals" by Frederick W. Taylor, M. E., Sc. D., which was the presidential address presented at the last annual meeting of The American Society of Mechanical Engineers, has been reprinted and bound in cloth by the Society, price $3.00. This or any other publication of the Society may be had by addressing the Secretary, 29 West 39th Street, New York. It is not necessary to send orders through members. None of the publications of The American Society of Mechanical Engineers are copyrighted.

moisture in the air or when frost was on. The paint was applied on girders in February, 1902, when the thermometer registered as low as 4 degrees above zero, and there seems to be no difference now in the general condition of this work, whether it was painted in summer or winter.

"At no time did the work over-run the estimate of cost, although the cost was slightly increased both for labor and material in the winter. However, this extra cost was only a trifle as compared to the care of the structures, and now after more than five years it is impossible to tell whether the structures were painted during the summer or the winter, as the general conditions are the same, and only by looking at the date painted on when finished can you tell when the work was done.

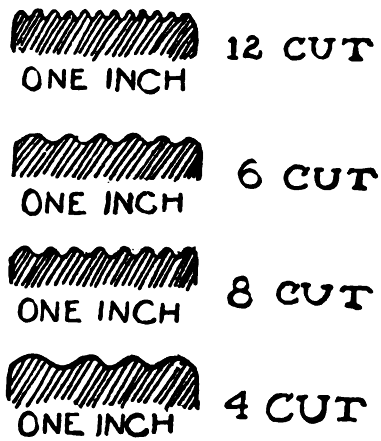
"All of these bridges received exactly the same treatment, having first been coated at the factory with boiled linseed oil, which was only a detriment to the surface. The oil bound fast the mill scale, rust, grease and blisters and in the field, without a sand blast, could only be removed by hand scrapers. After the steel was erected it received two coats of paint.

"The condition of the work had several advantages, by having a land climate without alkali, sea fog or gases, which are enemies to paint; yet it has had the disadvantages of being painted, in many cases, six months after erection, the coating of linseed oil and the drippings of salt brine from meat refrigerator cars.

"After experiences of this kind which may occur over and over again, it only convinces one that the time to paint is just as soon as the structure is erected and before rust starts. Like filling the purse, 'Little and Often' makes a good rule for painting, and the season of the year can not be considered when a structure needs paint."

Cutting Granite.

THE County Courthouse Commission at Cleveland are being censured for apparent changes from plans after contracts have been let. Some changes were said to have been made in the cutting of the face of granite blocks.



The accompanying diagrams illustrate the changes in the cut of granite. The 12 and 8 cut work required by the specifications have been changed to 6 and 4 cut.

These cuts indicate the number of times the tool that gives the surface of the granite

Incline and dump on the work at the Cuyahoga County Court House.

Fig. 1—Wood housing around mine fan.

Fig. 3—Metal housing around mine fan.

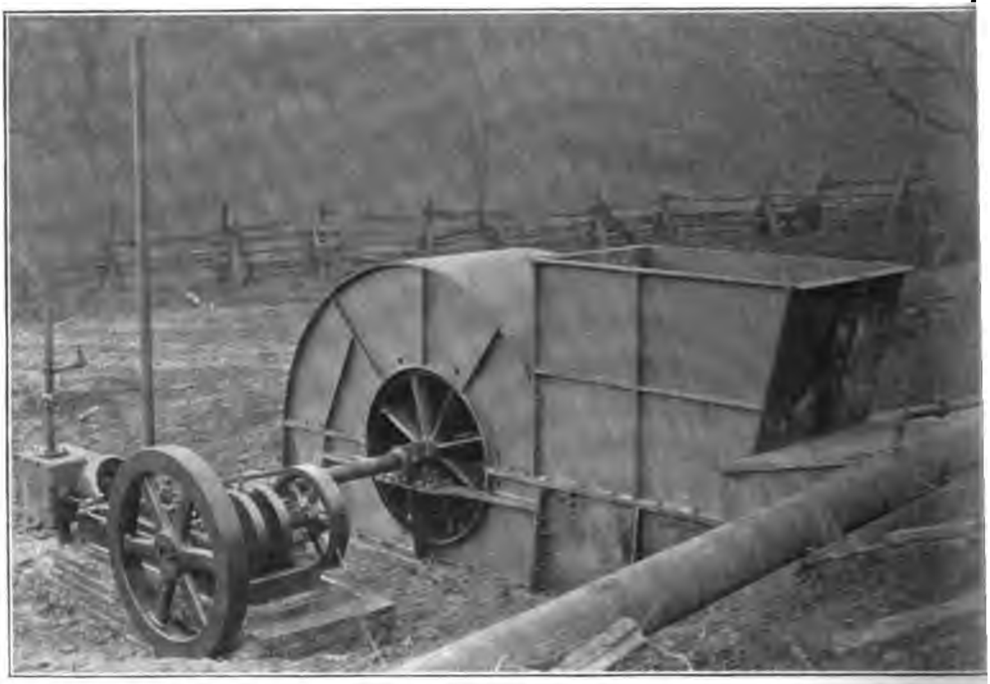


Fig. 4—Showing chain drive and metal housing.

Fig. 5—Another view of Fig. 4.

DESIGNER & DRAFTSMAN

Working Loads for Manila Rope.*

THE technical reference books in use by engineers do not contain definite information in relation to the proper working loads of manila rope, when used in tackle blocks or for cargo hoisting. The hoisting of heavy weights is an important branch of erecting work, and I desire to record in the proceedings of the society a statement of the result of an extended experience, together with some examples of the life of rope in actual service, which will be a guide to engineers in judging what service can reasonably be expected in similar cases.

The ultimate strength given in Table II is materially affected by the age and condition of a rope in active service, and also it is said to be weaker when it is wet. Trautwine states that a few months of exposed work weakens rope 20 to 50 per cent. The ultimate strength of a new rope given in column B, Table II, is the result of tests made by the company with which I am connected of full-sized specimens of manila rope, purchased in the open market, and made by three independent rope works. Prof. B. Kirsch, of the Imperial Royal Technological Industrial Museum, in Vienna, has broken over 200 specimens of rope, mostly 35 mm. (1⅜ inches) and 55 mm. (2⅛ inches) diameter, and his results agree within five per cent with these figures. These tests demonstrated that within the limits of commercial sizes of hoisting rope, the full strength could be obtained for larger as well as for smaller sizes. When the strength falls off, the rope is imperfectly laid, or made on a machine too weak for the work. The ultimate strength of rope is, in this class of work, useful for one purpose only; that is, to estimate the factor of safety with any given working stress. The strength given is for ordinary commercial rope, which may be greatly exceeded in strength by rope made of selected materials. The strength given in Table II can be depended upon as a reliable and safe guide in estimating the factor of safety for any case in hand.

The proper diameter of pulley-block sheaves for different classes of work, given in columns F, G and H (Table II) is a compromise of the various factors affecting the case. An increase in the diameter of sheave will materially increase the life of the rope. The advantage, however, is gained by increased difficulty of installation, a clumsiness in handling, and an increase in first cost. It can safely be assumed that the best size is one that considers the advantages and the drawbacks as they are found in practical use, and makes a fair balance between the conflicting elements of the problem. It would be rash for any one to attempt to make a decision from theoretical considerations; but an average of the practice of a large number of users working under all the various circumstances of financial stress or superabundance, or urgency or leisure, of mathematical analysis, or rule of thumb decisions, furnishes an acceptable basis for a decision as to the limits of good engineering practice. That average the table aims to give.

An abundance of data is available from which to draw a reasonable conclusion in the premises. A few typical illustrations will make clear the method of procedure, and also be of service in showing what changes in size or proportions an engineer, in any given case, could make to reach a higher efficiency of mechanism, or a greater commercial economy. In driving 28,908 piles on the Chicago, Milwaukee and St. Paul Railway, the engineering department kept an accurate account of the number of piles driven by each one of the 79 lines of various sizes of manila rope used. From this record the average number of piles driven by each size of rope was computed, and

*Reprint from article on this subject by C. W. Hunt in Vol. XXIII, Transactions of Amer. Soc. Mech. Engrs.

[illegible] the cost of rope per pile driven was ascertained. This account showed that for hammers weighing from 1800 pounds to 2600 pounds $1\frac{1}{2}$-inch diameter rope was the best, and for hammers from 2600 to 3200 pounds, rope $1\frac{3}{4}$ inches in diameter should be used.

Similar records covering many years have been kept by various coal dealers, of the [illegible]meter and cost of their rope per ton of coal hoisted from vessels, using sheaves of from 12 to 16 inches in diameter. These records show conclusively that, in hoisting a bucket that produces 900 pounds stress upon the rope, a $1\frac{1}{4}$-inch diameter rope is too small and a $1\frac{3}{4}$-inch rope is too large for economy. The size in general use for this [illegible] is $1\frac{1}{2}$ inches. The Pennsylvania Railroad Co. use $1\frac{1}{2}$-inch rope, running over 14-inch diameter sheaves for hoisting freight on [illegible] their lighters in New York harbor, and handle on a single part of the rope loads up [illegible] 3000 pounds as a maximum. Greater weights are handled on a 6-part tackle.

Robert Grimshaw, in 1893, in collaboration with Lieut. J. A. Bell, of the Equipment Bureau, U. S. N., made a series of tests at the Brooklyn Navy Yard on sheaves of various diameters and with various loads. "The rope was ordinary manila, 3 strand, $3\frac{1}{4}$ inches in circumferences, such as is used in the United States navy. It was dry, and tested on a 'cat and fish' tackle constituting a 6-fold purchase; sheaves were 8 inches in diameter, the three upper ones having roller bearings and the three lower ones plain solid bushings. The lower block and hook weighed 75 pounds." The result of these tests, so far as they are pertinent to this paper, are given in Table I.

TABLE I.

(From Grimshaw Report.)

Net load on tackle Weight raised	Theoretical Amt required to raise the net weight	Actual power required	Extra power required over the theoretical.	
600 lbs.	100.0 lbs.	158 lbs.	58.0 lbs.	58.0%
800 "	133.3 "	198 "	64.3 "	48.0 "
1000 "	166.7 "	243 "	76.0 "	45.8 "
1200 "	200.0 "	288 "	88.0 "	44.0 "

It is interesting to compare the life of a rope when used with the stresses and sheaves given in columns C and F (Table II) with one when used with those of columns D and G. To illustrate this, take two cases using exactly the same size and quality of rope; one to be worn out in hoisting coal from vessels, with stresses and sheaves as per columns D and G, and the other to be used on a rope drive with the stresses and sheaves as per columns C and F; all the wear on the rope comes from its interval friction in bending over sheaves, and its external chafing in running on and off them. A record of the number of bends made by each of the ropes during its life will be a convenient means of comparison. A rope $1\frac{1}{2}$ inches in diameter usually hoists from a vessel from 7,000 to 10,000 tons of coal on a well-averaged hoist. The rope will have a working stress of from 850 to 900 pounds running over three sheaves, one 12 inches and two 16 inches in diameter; in hoisting 10,000 tons it makes 20,000 trips, bending in that time from a straight line to the curve of the sheave, or vice versa, 120,000 times. The rope, when this service is completed, is worn out and must be replaced by a new one.

TABLE II.

Working Load for Manila Rope.

A	B	C	D	E	F	G	H
Diam. of Rope Inches.	Ultimate Strength Lbs.	Working Load in Lbs.			Min. Dia. Sheaves in Inches		
		Rapid.	Medium.	Slow.	Rapid.	Medium.	Slow.
1	7100	200	400	1000	40	12	8
$1\frac{1}{8}$	9000	250	500	1250	45	13	9
$1\frac{1}{4}$	11000	300	600	1500	50	14	10
$1\frac{3}{8}$	13400	380	750	1900	55	15	11
$1\frac{1}{2}$	15800	450	900	2200	60	16	12
$1\frac{5}{8}$	18800	530	1100	2600	65	17	13
$1\frac{3}{4}$	21800	620	1250	3000	70	18	14

To illustrate the endurance of the rope used in the transmission of power, take a tin-plate mill transmitting 1000 horsepower to the rolls by means of $1\frac{1}{2}$-inch diameter manila ropes. In one particular case the sheaves are 5 feet and 17 feet in diameter and 36 feet apart, center to

center. The rope is 86 feet long, runs 5,000 feet per minute, making 13,900 bends per hour, or more bends in 9 hours' service than the other rope made in its entire life. As is well known, the life of a transmission rope is measured by years, not hours. This enormous difference in the life of ropes of the same size and quality is wholly gained by reducing the stresses on the rope and increasing the diameter of the sheaves.

TABLE III.

The Efficiency of Knots in a Percentage of the Full Strength of the Rope, and the Factor of Safety when used with Stresses, as per Column E, Table II.

I	J	K	L	M	N	O	P
	Eye Splice over an Iron Thimble.	Short Splice in the Rope.	Timb'r hitch,ro'nd turn & half hitch.	Bowline Slip Knot Clove Hitch.	Square Knot, Weavers' Knot, Sheet Bend.	Flemish Loop, Overhand Knot.	Rope dry. Av. of 4 tests from same coil as the knots.
Efficiency of Knot......	90	80	65	60	50	45	100
Factor of Safety........	6.3	5.6	4.5	4.2	3.5	3.1	7

The weakening effect given in Table III of various knots, hitches and bends used in rope tackle is based upon experiments made in the laboratory of the Massachusetts Institute of Technology. Forty-five pieces of 2½-inch circumference, three-strand manila rope, cut from one coil, were broken in sets of from three to seven ropes, each rope of a set having the same fastening, and the average strength of each set being computed. Each different set tested some one of the fastenings in common use. The results were not erratic, but consistent, and from them a safe conclusion can be drawn. In examining the various knots broken, it is evident that those fastenings in which the standing part makes a short bend over another part of the rope are the weakest. Those like a round turn and a half-hitch, or a timber hitch, have a less abrupt bend in the standing part, and are materially stronger. With care, an eye in the end of a rope having the ends of the strands tapered down, can be spliced over an iron thimble so that it will have substantially the full strength of the rope; but as an eye is usually made it is not so strong, for which due allowance is made in the table. The same remarks apply to a splice in a rope. In the table some knots are included which were not tested, but whose approximate strength is evident from their formation. The table is to be used only as a guide in estimating the factor of safety. The loss of efficiency by the use of knots was conclusively settled by the experiments above mentioned, and the numerical value fixed within such narrow limits that the result cannot safely be ignored in executive work.

It will be understood that a table of working loads must be a general one, covering ordinary cases arising in practice. Local conditions may be such as to make it advisable to vary from the stresses given in the tables. In cases of great importance an engineer should carefully investigate the subject in detail, and then decide upon the exact stresses that he will put on his tackle, but ordinary cases are fully covered by the data given in the tables herewith.

In this table the work required of the rope is, for convenience, divided into three classes—"rapid," "medium," and "slow," these terms being used in the following sense:

"Slow"—Derrick, crane, and quarry work; speed from 50 to 100 feet per minute.

"Medium"—Wharf and cargo, hoisting 150 to 400 feet per minute.

"Rapid"—400 to 800 feet per minute.

The diameter of the rope in column A is obtained by dividing the girth by 3.1416. This method gives for a three-strand rope nine-tenths, and for a four-strand ninety-three hundredths of the diameter of a circumscribed circle. The girth method corresponds closely to the circular diameter of the rope when under stress, and is the most convenient method of measuring.

The efficiency of knot in a percentage of the full strength of the rope, and the factor of safety when used with stresses, as per Column E, Table II:

The existence of coal and lignite deposits in Montana territory has been known for some time, but their development and utility are of quite recent date. In 1880 only 224 short tons of coal, valued at $800, were reported to have been dug from Montana mines, while in 1906 over 2,000,000 tons, valued at something over $3,000,000, were placed on the market; besides many thousands of tons that were used for local domestic purposes. There are now about fifty operators in the state, both large and small, and others are coming in each year

Photographing Machinery.

BY A. EDWARD RHODES.

I[illegible] is generally conceded by photographers [illegible] one of the most difficult objects to [illegible] a satisfactory photograph of, is a [illegible] of machinery. The reason for this is [illegible] upon a little consideration, and [illegible] the fact that machinery almost always [illegible] of parts which are unfinished, and [illegible] a dark color, while other parts are [illegible] finished, and often polished, and there-[illegible] nearly all the light which falls [illegible]. The result is, that when a negative [illegible] long enough to bring out the dark [illegible] the machine distinctly, the exposure [illegible] for the finished parts, and if on [illegible] hand, the exposure is timed for the [illegible] parts, the darker portions are usually [illegible] by black patches which show abso-[illegible] of form or construction.

[illegible] made many experiments to overcome [illegible], among others, that of using [illegible] with reflectors placed so as to illumi-[illegible] dark portions. This makes the ma-[illegible] about right to the eye; but since [illegible] light, except electric light has any [illegible] effect upon a photographic negative [illegible] conditions) the results were not [illegible]

[illegible] where I saw a plan which has never [illegible] give good results. It is as follows: [illegible] machine all over; using for the [illegible] parts a paint mixed with any oil which [illegible] readily harden or dry out, so that [illegible] exposure is made, the paint may [illegible] wiped off. By this method all parts [illegible] machine can be made to reflect light [illegible]

[illegible] good idea, also, to have several dif-[illegible] of this paint, and after the first [illegible], any parts which do not come out [illegible] may be painted lighter, while those [illegible] too light may be painted darker, [illegible] by a few experiments, a perfectly [illegible] negative may be obtained.

[illegible] a matter of considerable importance [illegible] manufacturers and mechanics, whether [illegible] photographs to send to prospective [illegible] or whether they are taken for en-[illegible] work from.

[illegible] Illuminating Co., Detroit, has [illegible] its Beecher avenue sub-station a [illegible] electric Northern crane, manu-[illegible] the Northern Engineering Works, [illegible]

The Heating and Ventilation of Buildings.

BY ARTHUR E. FREEMAN.

IN the three preceding articles on the heating and ventilating of buildings, which have successively appeared in the Industrial Magazine, the various problems that are to be met in the design of systems for modern school buildings of all sizes were treated and it remains for us to apply the various principles to the other classes of structures.

HOSPITALS.

The three ends which are to be aimed for in system of heating and ventilation for hospitals are first, cleanliness and quietness; second, abundance of fresh air; and third, even and warm temperatures.

In consideration of the first point the air supplies must be not only pure but free from dust and radiators should be kept out of the wards and other rooms to be used by patients whenever possible, as radiators exposed in rooms are good dust catchers. Great care should be exercised in the design of the system as to proper pipe sizes, especially if a steam system is to be used, as the hammering of the condensation in the pipes will be annoying if it is allowed to occur. For the smaller hospitals a hot water system is often used as it is always quiet and easily controlled. In the larger hospitals and institutions which may be made up of several buildings, having their heating supply come from a central plant, hot water is not feasible unless a forced circulation system is installed. This latter method is an admirable one for heating a large hospital building or group of buildings owing to the ease with which it can be controlled. It requires only an adjusting of the temperatures of the circulating water to keep the buildings at the desired proper temperature, this adjustment being made at the main heaters. The system is absolutely quiet and, when properly designed, gives perfect satisfaction.

The second point is more important in this class of buildings than any other for it is absolutely essential that the air be as pure and sweet as possible. Different amounts of air are devised per patient per hour by various authorities on the subject but good satisfaction will be obtained if from 5,400 to 6,000 cubic feet are supplied per hour to each per-

son in the ordinary wards and from 6,600 to 7,200 cubic feet per hour to those in the contagious wards.

This amount of air generally means a fan system with supplementary heaters at the base of the flues. The double duct system, as explained previously, is a very good system to apply to this class of building. The sizes of the heaters can be figured exactly as in the case of the school buildings, due consideration being taken of the amounts of air to be heated for the supplies.

In the wards containing from 8 to 12 beds very good results may be obtained by having a fireplace at one end of the room and placing a coil of about 20 square feet radiation in the chimney to ensure a draft. The flue should have at least 4 square feet area and a vent should be left in the ceiling at the other end of the room for summer use.

The placing of the supply and vent registers should be such that drafts cannot be noticed by the patients and the air velocities should be kept rather low. The supply flues should have an area of about 100 square inches for each bed in the ward. The vents from the single wards should not be smaller than 8" x 12" and in proportion for the larger wards.

The supply air is usually drawn from a cold air room provided for the purpose in the basement. A common plan is to use the whole basement for this purpose.

Vent flues except fire place flues should be collected in the attic and passed out through the roof. Roof vents should have a sectional area of about 7-10 of the combined area of the vent flues proper.

The air in the operating room should be changed at least once in ten minutes. A small disc fan will be very convenient to discharge the air from the operating room directly outbound, thereby readily ridding the room of all ether fumes. A coil of 1¼" pipe is often run around the skylight to prevent cold down drafts from that source.

The toilet rooms and halls are treated in a similar manner to those in school buildings and direct radiation is used.

THEATRES.

The heating and more especially the ventilation of a theatre should demand the careful attention of the engineer, for a proper solution to the problem is very desirable.

From the standpoint of the heating engineer a theatre is divided into three parts—the auditorium; the stage and dressing rooms; and the foyer, lobby, corridors, offices and other small rooms.

The auditorium may be heated either by the indirect method or by the direct system. Usually the direct system is desirable as by that system the temperature of the auditorium can be brought to the desired point before the audience arrives without starting the fans.

In the heating of the auditorium we have to deal with a quantity that we have not met before, namely the heat that is given out by the people themselves and an allowance of from 8 to 10 degrees Fahr. can be made. Consequently the temperature of the air supply can be dropped from 70 degrees to say 65 degrees soon after the audience has assembled.

The ventilation of the auditorium is best accomplished by the upward system. Fresh air from the fans should be blown into a plenum chamber situated under the auditorium and extending under the whole floor. The air is then diffused through many small openings, usually located in the legs of the seats, thus giving a uniform supply of fresh air in the required quantity over the whole floor of the auditorium. About 1,200 to 1,500 cubic feet of air should be supplied per capita per hour.

The vents should be located in the ceiling and also in the walls at the rear of the balconies, the latter serving to draw the air across the balconies thereby keeping the air constantly changing. The vents should connect to an exhaust fan and the air thus positively expelled. Air in the vent flues, where fans are used, should not have a velocity over 700 feet per minute.

Dressing rooms, which are usually small even in the large theatres should be well ventilated and should have a positive air supply. This means a fan and the complete air change in these rooms should be made at least once in ten minutes.

The foyer, lobby, corridors, etc., should be heated by direct radiation and no indirect air supply need be furnished. Care should be taken to have the radiation heavy enough at the entrances to compensate for the frequent opening of doors and the consequent cooling effect of the inrushing air.

CHURCHES.

Small churches can be well heated by the use of one or more good hot air furnaces These furnaces should have register openings

14. Are there dimensions not tied up?

15. Is there allowance for driving and running fits in thousandths?

16. Is there allowance in bolt and rivet holes?

17. Is there pitch of the thread and the standard on bolts and tapped holes?

18. Is thread of the proper pitch for the metal used?

19. Are the size of tap drill and clearance drill given?

20. Are nuts and bolts locked? Is there plenty of clearance to use a large wrench on the bolt heads?

21. Are sizes of all bosses suited to their purpose?

22. Are dimensions not to proper scaling underlined?

23. Are the title, scale, number, date and notes correct?

24. Are the bolt and screw heads shown correctly?

25. Are tapped holes shown correctly?

26. Are there round corners and fillets?

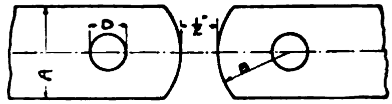
27. Are there dimensions on springs?

28. Are there fractional dimensions which it is possible to avoid?

29. Are right and left pattern numbers correct?

30. Are there advantages for selling or operating?

Cutting Lace Bars.

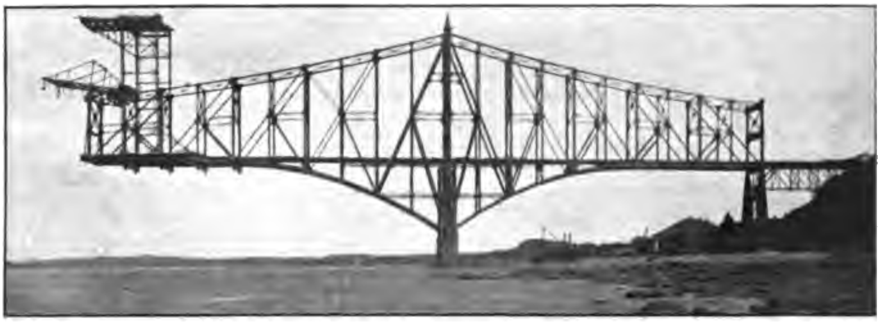


No.	A	B	D
1	1¾	1⅛	9/16
2	2	1¼	11/16
3	2¼	1½	13/16
4	2½	1½	13/16

Cement is packed in bags and barrels. The bags average 94 pounds each and it has been stated in print that 4 bags fill a barrel. Barrels packed tight hold 375 pounds (average) and contain 3.5 to 3.8 cu. ft.

More patents were applied for and more patents issued and reissued by the United States government in 1906 than in any other year in its history. The number of applications was 56,482 and of patents 31,965.

Representing the government of Japan, and several of the largest manufacturing and other firms of their country, six prominent Japanese citizens arrived in Seattle May 27 to spend $10,000,000 in the purchase of machinery, armament and raw materials.



The span that failed and was wrecked.

naturally is aroused as to whether the engineering imagination of the age, strikingly as it has been justified, has not o'erleaped itself in the effort to apply the cantilever principle in bridge construction beyond the point of absolute safety.

Of the $3,500,000 that had gone into the bridge a great share is wholly wiped out, while the loss of life is very large. The blow to Quebec will be a heavy one. The lack of a means of crossing the river below Montreal, save by ferries, has for years held back the development of the picturesque old city on the heights. The effort to get funds by which this work has been carried on has been enormous. A subsidy of $1,000,000 was secured from the Dominion and another of $350,000 from the government of the province of Quebec, while the city of Quebec gave a grant of $300,000. The promoters put up $600,000. The disaster to the hopes and plans will make investigation of the cause of the ruin a most earnest one. The construction of the piers will receive the closest examination.

This bridge, which will have the longest single span in the world, crosses the St. Lawrence river seven miles above Quebec, Canada, and is being built for the Quebec Bridge and Railway Co. All the steel work for this bridge was designed and fabricated by the Phoenix Bridge Co. at Phoenixville, Pa., and is being erected by the same company.

The two 210-ft. deck truss approach spans were erected on falsework in 1902 and 1903, but erection of the main structure was not actually begun until July, 1905. From that time until the end of November of the same year, six panels of the south anchor arm were erected on the falsework, a total weight of 5,346 tons.

The steel falsework was especially designed and fabricated by the Phoenix Bridge Company for the support of the anchor arms, during their erection, and weighs 950 tons. The yellow pine timber falsework,

placed under the anchor arms for the temporary support of tracks for delivery of metal to be erected, is built of specially selected stock, furnished by George Warner, of Philadelphia, and consists of transverse bents of five 12-in. by 14-in. vertical posts spaced 50 ft. and braced in both directions.

Riveting gang far above the St. Lawrence.

Showing manner of securing ten members of the structural work.

During the season of 1906 the south anchor arm was completed and the south cantilever arm erected, a weight of 10,423 tons.

On account of the severity of the climate, it is necessary to suspend work on erection from December 1 to April 1 each year.

All metal and other material for the construction of the bridge is shipped to the storage yard, which on the south side is located one mile from the bridge site. Here all material is temporarily stored under a crane runway 990 ft. long and 67 ft. wide, through the center of which runs a single delivery track. The members are handled from the cars by two 55-ton electric cranes, and again loaded on flat cars by these cranes, and shipped to the bridge when needed. Current for the operation of the storage yard cranes, as well as for all work done on the bridge, is furnished from the Chaudiere Falls Plant of the Canadian Electric Light Company, about three miles distant, as a 2,400-volt alternating current, and transformed at a sub-station on the ground to a 550-volt direct current for use in the crane motors. A similar storage yard will be used on the north shore to handle the other half of the bridge.

All members of the anchor and cantilever arms are lifted from the cars run out under its overhang, by the big steel traveler, and swung into place. Operating on this traveler are four 125-horsepower, double-drum, four-spool hoisting engines, designed and built by the Lidgerwood Manufacturing Company, of New York, especially for this work. Each engine is driven by a direct current motor, made by the Canadian General Electric Company, of Toronto, Ontario, which runs by current delivered from a sub-station, to be mentioned later. Two drums on each engine handle the eight sets of thirteen part falls of ⅞-inch steel wire rope made by the John A. Roebling's Sons Company, of Trenton, N. J. The nominal capacity of these sets of falls is 55 tons each, and the total length of wire rope is 7 miles. In order to properly handle the loads, special steel sheave blocks, with sheaves 24-in. in diameter, and weighing 3,800 lbs. each, were specially designed and built by the Boston & Lockport Block Company, of Boston, Mass., and furnished through their Philadelphia agents, Uhler & English. These blocks are the largest and heaviest ever used on erection work. The manila rope on this traveler, from 1½ to 2 in. in diameter, in single lengths of 2,800 ft. and less, aggregates about 13 miles in length. This rope, made by the Plymouth Cordage Company, and furnished also by Uhler & English, is used in four and three-sheave wooden blocks with capacities of 22, 17 and 10 tons each, which blocks the same firm also secured for this work from the Boston & Lockport Block Company.

With this equipment there has been no difficulty in handling all of the truss members, the heaviest of which reach 100 tons, and very often members of both trusses are raised and placed simultaneously.

An interesting feature of the Quebec Bridge is the eyebars, used for tension members. These were rolled at the mills of the Central Iron & Steel Company, of Harrisburg, Pa., and forged by the Phoenix Iron Company, and, with the exception of the 10-in. anchorage bars, and a few 12-in. top chord bars are of a uniform width of 15 in., from 1⅝ to 2¼ in. thick, and up to 76 ft. in length. Owing to these heretofore unheard-of dimensions in eyebar manufacture, unusual care was required in the handling and shipping of these important parts of the structure, and the results obtained reflect great credit upon all concerned.

The erection of the eyebars necessarily required special attention, and in order to save both time and liability to injury, a scheme was devised by the contractors by which all bars constituting a single member

Manner of driving the huge pins through eyebars and anchor arms.

were spaced properly, securely clamped together in this position, and raised into place in a bunch. The raising of the two top chord panels of 28 eyebars each of a total weight of 160 tons, and placing them in position, at a considerable angle with the horizontal, 300 ft. above the river was quite a feat. The falls attached to the far ends of these bars were those of steel wire rope previously mentioned, in the special 3,800-lb. blocks. The ones at the near ends were the 2-in. and 1¾-in. manila falls.

Although the thorough work in the drafting rooms of the Phoenix Bridge Company, at Phoenixville, Pa., where the whole structure was detailed, cut down the number of field rivets to a minimum, there still remained 550,000 to be driven from ⅝ in. to 1 in. in diameter and many through plates aggregating over 7 in. in thickness, and in spaces exceedingly cramped and narrow. To make this possible The Chicago Pneumatic Tool Co., whose tools are used quite extensively in this work, designed special, short, automatic hammers. The particular work for which these hammers were designed was the driving of 1-in. rivets on the inside ribs at bottom chord splices, which it would have been impossible to do with the ordinary pneumatic hammer.

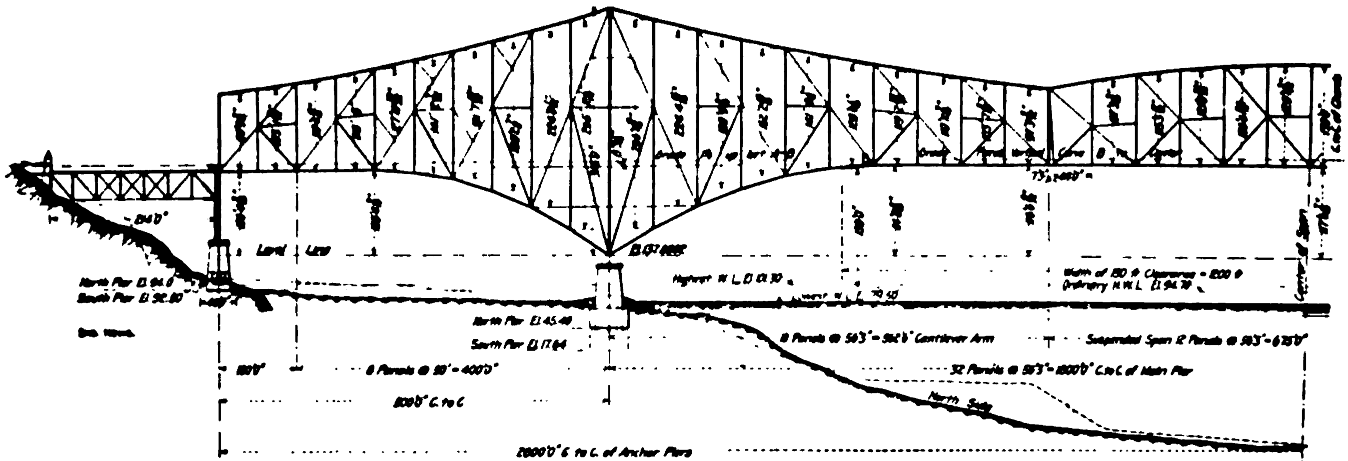
All main connections on the anchor and cantilever arms of the Quebec Bridge are made with pins, from 9 in. to 24 in. in diameter, and up to 10 ft. in length. The driving of all these pins has been a matter of great interest, and has been accomplished by the swinging of a 4,000-lb. ram from the top of the traveler, and operating it with a gang of from six to eight men, in the usual manner, on a working platform suspended under it.

The most difficult part of the erection work has been the handling of the sections of the main posts, especially those which, when in position, reached very nearly to the traveler clearance line on top.

The highest points on the bridge are the peaks of the main posts, reaching from the tops of the big masonry piers to a height of 400 ft. above the water.

The absence of smoke, noise and confusion is especially noticeable to a visitor at the bridge site, due chiefly to the admirable electric installation for handling all lifts.

As at the storage yard, previously described, a 2,400-volt alternating current is delivered by the Canadian Electric Light Company to two sets of motor-generators, made by the Allis-Chalmers-Bullock Company, of Montreal, in a sub-station on the approach span, and sent from them a 550-volt direct current, to the engines on the traveler, and all other motors on the work. The high tension current, as before mentioned,



HALF ELEVATION DIAGRAM OF QUEBEC BRIDGE.*

The reader will, no doubt, realize that the sections over the river that support the center span must have required a great amount of engineering ability in order that the stresses and strains be thoroughly figured. One would think that the cantilever type of bridge has its limitations, and that a suspension form would be the proper design for this place.

* Courtesy of Engineering News through Engineering-Contracting.

comes from the Chaudiere Falls, where two General Electric and one Allis-Chalmers-Bullock turbo-generators are installed in a plant taking its power from one of the most beautiful waterfalls in America.

This being one of the first times electric power has been used on structural steel erection work of any magnitude, the outcome of the experiment has been watched with interest, and the fact that no delays or breakdowns have yet been experienced speaks well for this power for such use in general, and for this installation in particular.

All riveting, drilling and reaming is done by compressed air, furnished by two Herron & Bury compressors, made by the Bury Compressor Company, of Erie, Pa., and also driven by General Electric motors. The air is delivered through a 3-in. main, at a pressure of 90 lbs. to branches that reach all parts of the work.

After the completion of the south anchor arm, the timber falsework, before mentioned, for the temporary delivery tracks, was no longer necessary and it has been almost entirely removed and transferred to the north shore for use there.

In order to facilitate some of the connections in the cantilever arm trusses, provision has been made to raise or lower each anchor arm panel point, as necessary, by powerful 500-ton hydraulic jacks, made by the Watson-Stillman Company, of New York, and placed between the special, steel camber blocks, which rest on the grillage of "I" beams and timber on the top of each tower of steel falsework.

Two of these 500-ton jacks, placed under a point, are sufficient to raise or lower the weight over them in every case.

The contractors for the masonry were Messrs. M. P. & J. T. Davis and for the superstructure the Phoenix Bridge Co., as noted above.

The summary of the dimensions and points of interest are here given.

Type of bridge, cantilever.

Total length of bridge between abutments, 3,220 ft. Consists of two deck truss approach spans, each 210 ft. long; two anchor arms, each 500 ft. long; two cantilever arms, each 562½ ft. long; one suspended span, 675 ft. long, the longest simple truss span ever built.

Central span, center to center of main piers, 1,800 ft., the longest in the world.

Type of trusses, pin-connected.

Width, center to center of trusses, 67 ft.

Depth of trusses varies from 97 ft. at the portals to 315 ft. over main piers.

Clear headway over high tide, 150 ft., for a width of 1,200 ft.

Investigations of Structural Materials.

By Richard L. Humphrey,

Engineer in Charge of the Structural Material Divisions, U. S. Geological Survey.

WITH the problems arising from the growing scarcity and consequent increase in the price of wood, principally lumber used in building construction, the search for a desirable substitute becomes a matter of prime importance, and justifies the work now being done by the United States Geological Survey at its structural materials testing laboratories at St. Louis.

The increased use of concrete in many forms during the past few years, especially for building purposes, has created a great demand for information regarding the structural value of this material. For a number of years limited investigations designed to obtain this informaton have been carried on by a number of investigators throughout the country, but no serious attempt at co-operation in this work had been made until a few years ago, when the United States Geological Survey, recognizing the need of information and co-operation, procured a small appropriation for making tests of structural material and invited various technical societies to take part in the work.

A committee called the Joint Committee on Concrete and Reinforced Concrete was invited to assist in outlining the work at the labora-

Fig. 1—Three Concrete Testing Machines.

The equipment of the laboratories at St. Louis for carrying on this work is very complete. In addition to all needed smaller apparatus there are four testing machines of 200,000 pound capacity and one of 100,000 pound capacity, suitable for testing beams and other structures used in buildings. These machines will test beams up to twenty feet in length and are equipped to make tests of the different materials used in construction work. Three of these machines used in the beam division are shown in Fig. 1.

In addition to the above machines a very large machine, having a working capacity of 600,000 pounds, will in a few weeks be installed at the laboratories at St. Louis. As far as known at this time there is only one other machine in the United States similar to this. This machine will make it possible to test columns, beams, and in fact all the different kinds of construction material now used. It will test very large reinforced concrete girders up to spans thirty feet in length and concrete columns up to thirty feet in length.

The value of such tests as these is readily apparent, since their results can be applied directly to practical work. A very serious objection to the use of results obtained in tests made by private investigators is due to the fact that the tests were applied only to small specimens not nearly

Fig. 3—Room in which Concrete Beams are stored.

the beam division, the concrete block division, the permeability, the shear and tension and the chemical division are equipped with all apparatus necessary for conducting their tests.

Although reinforced concrete is used to a remarkable extent at the present time, and both concrete and reinforced concrete construction is becoming more and more popular every day, it is evident to anyone familiar with construction work that these materials will be more generally employed within the next few years. Many engineers are prejudiced against the use of concrete and reinforced concrete, but this prejudice is rapidly being removed by the obtainment and publication of reliable data regarding this material. Without doubt, in a very few years, when most of the principles underlying the use of concrete and reinforced concrete have been fully established from tests and investigations, there will be little prejudice against the use of concrete; the present prejudice evidently being due to lack of information.

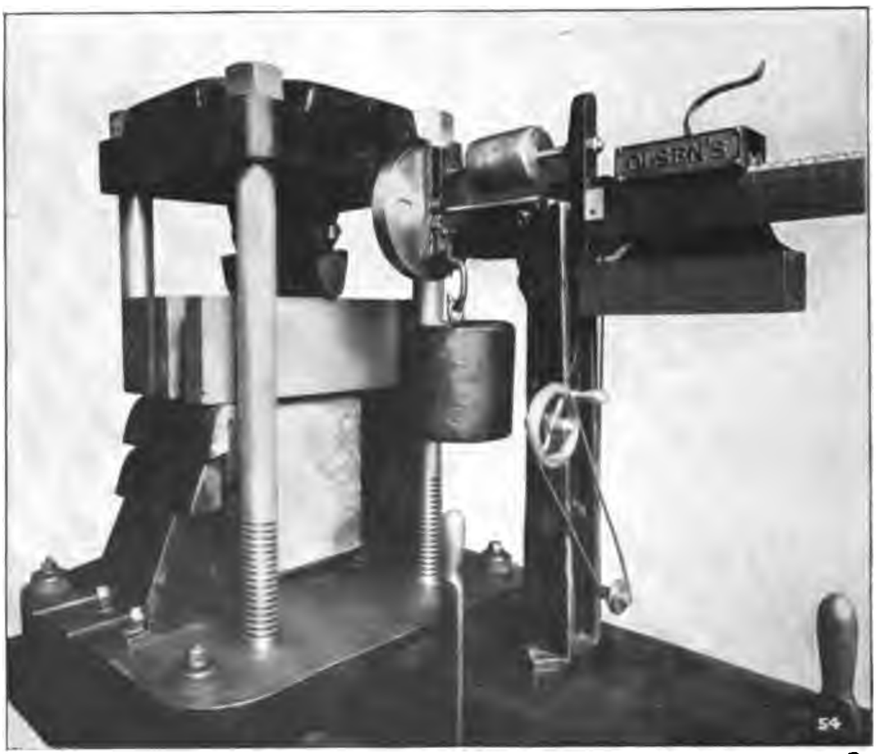


Fig. 5—Testing Concrete Block.

Fig. 6 –Testing Fire-proofing Qualities of Concrete, etc.

A branch of the work that should be of interest to everybody, especially the small home-builder, is the investigation of cement building blocks. Many houses are now built of cement blocks in preference to wood, because generally cement block construction is cheaper and better than wood, since it is fireproof, more durable and less expensive to maintain. The exterior surfaces of wooden buildings must be painted, and clapboards must be added from time to time; but when the cement block building is finished, the surface is there once for all; no further treatment, no repairs, no maintenance are necessary.

All the cement blocks used in these investigations are mixed in the concrete block machines shown in Fig. 4. The concrete is mixed in a one-third cubic yard cubical concrete mixer and deposited on the floor of the testing room. It is then shoveled into the hollow block machines and compacted very firmly in the forms. Varying proportions of concrete, sand, and stone are used in order to determine the relative value and economy of using different mixtures. Some blocks are made of wet concrete, others of concrete very dry, and still others of concrete having

The art of fire-proofing has been developed rapidly within the last few years, but there is still much to be done, especially in relation to the fire-resisting properties of concrete. In order to obtain information to meet these needs a series of fire tests are being carried on by the Geological Survey at the Fire Underwriters Laboratory at Chicago.

For this purpose a hanging door having a steel frame and a one-foot wall of fire brick inside of it is used. At the center of this frame there is an arched opening of about the size of an ordinary door. For the fire tests this opening is built up successively with different materials, ordinary building brick, fire brick, hollow tile blocks, the different kinds of cement buildings blocks, stone, concrete and terra cotta. When the opening is filled with cement blocks, it has the appearance shown in Fig. 6. After the opening is filled, a flaming gas jet is played all over the door for a long time and when the heated surface is very hot, the gas is turned off and the door allowed to cool. In some tests the cooling takes place slowly, in others a stream of water is played on the door immediately after the gas is turned off in order to reproduce as nearly as possible the actual conditions in a fire.

When these tests are completed, the results will not only show engineers and architects what material is best for fire-proofing and how much should be used to produce the best results, but will also teach the small builder, the builder of a home, what kind of a cement block is best adapted to make his house fire-proof.

It is the consensus of opinion among engineers that a reasonably fire-proof building can be constructed, and it is hoped that the art of fire-proofing will be so developed in the next few years that the public will also be convinced that this is true. It is also desirable that the public should be thoroughly informed as to fire resisting qualities of the various classes of building materials and it is expected that the work being done by the United States Geological Survey will furnish reliable information not only on this subject, but also in regard to the strength and other properties of these materials.

Warehouse from the Chicago River.

of the building each passing near to, or under one of the stairway openings. Spurs and switches branch from the main lines to the storage yard, and mixer bins. The equipment consists of flat and dump cars, turntables and turnouts of standard narrow guage type.

As there was such an enormous amount of form lumber to be worked up, and so much steel reinforcement to be handled, the builders thought it best to establish their own mills. Therefore a complete saw-mill was set up on the strip of land to the north of the building site. It was fully equipped with a planing mill, benches, staging, saws, both band and circular, and boring mills.

The girder and column forms are all assembled here, and then transported directly to their places by the derrick system. A steel mill is similarly equipped and with its storage yard occupies the remainder of the vacant ground.

Seventy-five hundred tons of reinforcement was used. That for the girder and floor beams is of the Ransome twist bar type, furnished by the United States Steel Corporation. It was ordered in exact sizes and lengths and all bars of corresponding dimensions came in bundles weighing about 200 lbs. each. They are formed to shape by an ordinary

Derrick No. 3

Derrick No. 4

bending machine. The bars for each girder are assembled in the mill and so secured together that they can be readily handled on the railway and lifted into place by the derricks. The reinforcement for the columns is handled in the same way. This last consists of vertical bars securely bound together by spirally wound steel rods, each very cose together. This results in a column with a high resistance to bursting.

The steel and wood mills are both served by a spur of the C., M. and St. P. Ry., which passes behind them. The steel is stored in racks in the yard, while the lumber, cut to length and sized, is piled behind the saw-mill.

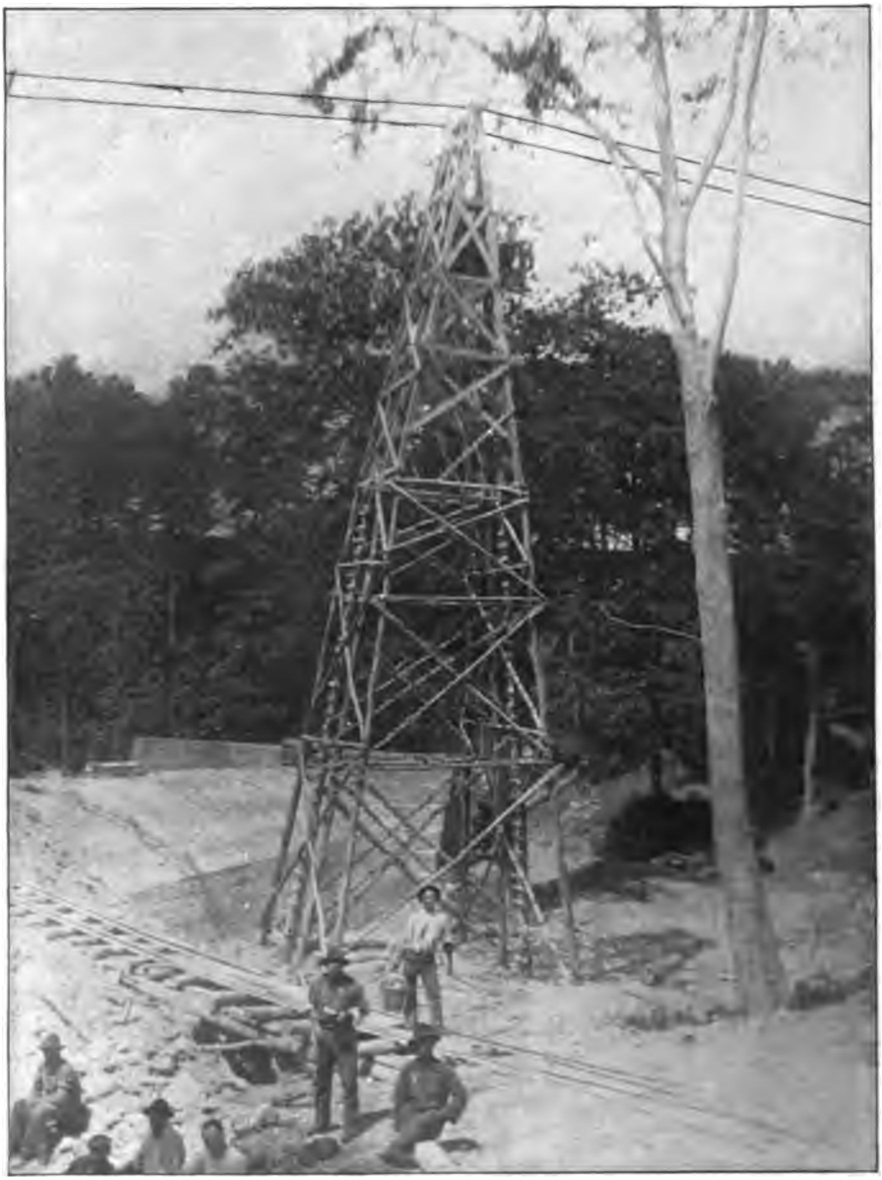
The raw materials, such as sand and gravel, are handled in two sets of bins and mixing plants which widely differ. That one near the south end is known as Bin No. 1, while the other, up near the north wall, is No. 2. The cars containing sand and gravel are switched onto the side track and dumped into hoppers underneath the rails. These are large enough to accommodate two carloads at once and they discharge through twelve openings onto an 18-in. belt conveyor, which carries the

Mixing Plant at Bin No. 2.

Derrick bucket showing gate and rectangular discharge bucket.

The plant at bin No. 2 differs quite materially from that at No. 1. The mixer is of the Smith type and is located on the basement floor, with the sand and gravel hoppers above it. A belt conveyor carries the gravel from bin No. 2 up to the chutes. The raw materials are mixed upon a platform and dumped directly into the machine. This mixing platform is elevated and the cement is carried to it by cars on the railway. As

The Montgomery, Ward and Co. has made arrangements to take over the large amount of form lumber and expect to work it up into packing cases. The work was done under the supervision of Mr. E. S. Belden, Superintendent for Geo. A. Fuller Co. The architects for the building were Messrs. R. E. Schmidt, Garden and Martin.



A-Frame for Cableway. 175,000 Yd. Fill made by Williams Bros. & Morse Company, New York.

The following is the actual cost of the aerial cableway:

1,000 feet 2¼″ Roebling galvanized bridge cable	$600.00
Eyebolts, 2½″, and clevises, for both ends	108.30
Two turnbuckles, at north end, 3″	120.00
Two chains, at north end, 10″ long, 2½″ iron	62.40
Four cast washers, 8″ dia., 2″ thick	2.46
Timber for A-frame (all other timber was obtained on ground) upper 42 feet, 14′ timber, 8″ x 8″, all bracing and cross ties, 3,200 feet at $34.00 per M (delivered)	108.80
Lower 50 feet, round timber, 56′ long, bought in tree	32.00
Cost of team work for hauling round timber, and pulling timber to place for erecting	65.00
Carpenter labor on A-frame and end bents on bank	231.40
Time of superintendent, getting material and overseeing work in general	60.00
Common labor, digging trenches for anchors, putting up cableway,	112.00
Nails and iron in A-frame and bents	29.40
Total cost of cableway	$1,531.76

Aerial Cableway constructed by Williams Bros. & Morse Co. between Stations 371 and 381, L.E. & P. Ry.

Conservative estimate made by Mr. A. E. Williams of the Williams Bros. and Morse Company on the probable cost of a timber trestle for this opening, figuring on square 8" x 8" timber cut from native timber.

98,000 feet (including all uprights, planks for X-bracing, stringers, etc.) at $26.00 M	$2,548.00
Labor for putting up trestle $6.00 per M	588.00
Spikes	98.00
Iron drift bolts	40.00
Total cost of trestle	$3,274.00
Saving effected by using cableway, estimated minimum cost of trestle	3,274.00
Actual cost of cableway	1,531.76
Difference in favor of cableway	$1,742.24

New York's New Railway Terminals.

By Warwick S. Carpenter.

TWO notable achievements of railway engineering are now rapidly nearing completion in New York City. They are are Pennsylvania Railroad's stupendous terminal and the new Grand Central Station of the New York Central Railroad. In both cases most of the preliminary work has already been done, and the companies are taking up the final stage of erecting the buildings.

At the Pennsylvania terminal all of the excavation between Seventh and Eighth Avenues has been completed down to grade and the steel work is being put in. Under Thirty First Street and Eighth Avenue the steel structure has been erected and traffic is now running over it. The rock has not yet been taken out under Seventh Avenue and before this is done the street is to be shifted to the west temporarily, until the excavation has been completed and the steel work put up, when the avenue will be shifted back. It will be upon its permanent steel foundation in about two months. In this section from Seventh to Eighth Avenues the sub-grade work, pipes, tunnels, tubes, etc., are proceeding rapidly. From Eighth to Tenth Avenues, the rock is being rapidly taken out and some of the sub-grade work has been commenced.

The North River tubes were finished several months ago, but it yet remains to put in their concrete lining. In the East River four tubes are going from each side and more than half the distance is covered. Nearly all of the excavation in the crosstown tunnels is done and the concrete lining is progressing rapidly. A noteworthy feature of these crosstown tunnels is that there has been practically no disturbance to the neighborhood. The Bergen Hill section of the tunnel in Jersey is being pushed in both directions through solid rock. The section of tunnels in Long Island City between the river and East Avenue, a distance of about two thousand feet, has been covered and concrete lining is now going on. The approaches east of East Avenue were begun recently and are progressing rapidly.

It is believed that at least two years will be required to finish the terminal structure and that it will be ready for use quite as soon as some other parts of the tunnel system. Excavating has been going on for three years and the work is now entering upon its final stage. When it is completed the floor space will accommodate 300,000 persons standing

First Locomotive used on the Pennsylvania Ry.

of electric locomotives, in order to determine which will be the best adapted for tunnel work. The experiments are being conducted on the Pennsylvania's West Jersey and Seashore Division and on the Long Island Railroad.

The locomotives, which were built by Westinghouse, are direct current, one being equipped with four 350 horse-power geared motors and the other with four gearless motors. The locomotive with gearless motors has one of its trucks equipped with two 300 horse-power motors supported by springs from the main journal and wholly independent of the truck frame, while the other truck has two 320 horse-power motors rigidly fastened to the frame. The advantages of these two methods of suspension will therefore be determined under identical conditions of service. The two locomotives are almost alike in appearance, resembling somewhat a short two truck passenger car with few windows and very large wheels. On account of their short wheel base the trucks have a

Pacific Type Locomotive of the Pennsylvania Ry.

First Electric Locomotive, Pennsylvania Ry.

tendency to tilt in operation and thereby shift a portion of the effective load from one pair of wheels to the other. By an ingenious automatic switching device the power delivered by the motor on the heavily loaded axle is increased and the power delivered on the lightly loaded axle diminished in proportion to the difference in axle loads. The pulling power of the locomotive is in this way increased twenty-five per cent.

The locomotive control mechanism is in duplicate, and placed in diagonally opposite corners of the cab, so that the motorman can operate a locomotive, or group of locomotives, from either end of the cab, in either direction. By means of a special grouping of switches it is possible to obtain a constant flow of current without a break, when changing from series to series parallel, and from series parallel to full-multiple. The preliminary tests made with the locomotive proved that, by means of this system of grouping switches, the acceleration of the locomotive could be made practically uniform. Both ends of the cab are provided with sockets, so that when two or more locomotives are coupled together connections can be made by means of these sockets, and the group of locomotives can be simultaneously operated and controlled by one motor-

Steel Car built at the Altoona Shops of the Pennsylvania Ry.

Erecting Steel Work to which Seventh Avenue will be temporarily diverted while the rock under it is being excavated. Pennsylvania Ry. Terminal.

man from one locomotive. The locomotives are equipped with hand, straight air, automatic, and high speed brakes.

The two electric locomotives, and the mammouth Pacific type of locomotive of the American Locomotive Works, represent the highest state of the art to-day, and are in interesting contrast to the first engine run on the Pennsylvania Railroad, which is shown in the illustration. The new steel cars turned out by the Altoona shops are equally up to date, and as far ahead of the old stage coach style of car as are the electric locomotives in advance of the early engines.

The improvements to the New York Central terminal which have been going on for over three years are five-fold. To the general public perhaps the most important of these is the electrification of all of the lines leading into the station for a distance of from seven to thirteen miles.

Of almost equal interest to the public has been the laying of additional tracks throughout the electrical zone. These two improvements, in addition to doing away with the smoke nuisance, quadruple the capacity of the lines leading into the station.

To accommodate the increased traffic it was necessary to plan for a very material enlargement of the yard. A large part of this has already been accomplished and the company is now ready to go ahead with the construction of the building itself.

A Yard Improvement Excavation Looking South from 48th St. New York Central Terminal.

and this alone requires no small amount of care and foresight on the part of the engineers who are conducting the work.

The new station will cover an area half as large again as the present site. To all intents and purposes, however, there will be three stations, two of them underground. The street level will contain the main ticket office, a large span for unchecked baggage, and other departments. The express level will be the first below the surface and below that the suburban level. A unique feature of the latter is the loop for switching incoming trains to an outbound track after they have discharged their passengers. This plan is unique and will very greatly facilitate the handling of traffic. Another important feature will be the connection with the city subway on this level, which will enable a person entering the subway downtown to go all the way to his destination at White Plains or other suburban stations without entering the open air.

Pennsylvania Railway Station, New York City

The Latest Development in Locomotive Cranes.

By Frank C. Perkins.

THE locomotive crane is operated in some cases electrically, and in other instances by steam power, both forms being utilized to advantage under proper conditions.

In Europe as well as in America the locomotive crane has been developed very highly as to efficiency in operation and ease of control and is one of the greatest labor savers of modern times.

The English crane shown in illustration Fig. 1, is constructed to lift a maximum load of 30 tons at a fixed radius of 27 feet. It is fixed with turning and traveling motions, worked by a motor with mechanical change gear for working either motion at pleasure. The crane travels upon eight steel wheels, 16 ft. gauge, carried by a wrought steel carriage. The crane is arranged to turn upon a live ring of rollers, placed between two wrought steel roller paths. The crane framing and jib are also of wrought steel, a wrought steel box being provided with the necessary counterweight at the tail.

The load is lifted by a four part extra flexible steel wire rope, winding one part on to a grooved barrel. The speeds of lift are as follows:

Ten feet per minute with 30 tons and 20 feet per minute on the quick gear with 10 tons.

The speed of travel is 50 feet per minute, and the speed of turning 100 feet per minute at the jib head.

Automatic, mechanical and electric brakes are fitted to the load gear, so as to make this motion absolutely safe.

The crane has been used to unload all the heavy material required at the Station from barges into trucks, and was tested with a load of 40 tons before being taken over.

The working current is three phase, 220 volts, and 25 periods.

The lifting motor is 40 B. H. P. and the turning and traveling motor 15 B. H. P. The controllers are of the metallic tramway type, working in conjunction with auto-transformers for varying the speed of the motors.

A corrugated iron house covers in the gearing and motors, the necessary doors and windows being provided for the convenience of the driver.

Fig 1—English 30-Ton Electric Locomotive Crane.

The accompanying illustrations, Figs. 2, 3 and 4, show American locomotive cranes utilized in various work, such as hauling of stone, the moving of large castings, railway trucks or machinery, and the handling of coal with heavy grab-buckets of large capacity; while the accompanying illustration, Fig. 5, shows the operating cab and controlling devices and levers of a German locomotive crane, the general construction of which is shown in the accompanying illustration, Fig. 6. The latter type of locomotive crane is largely utilized in railway service

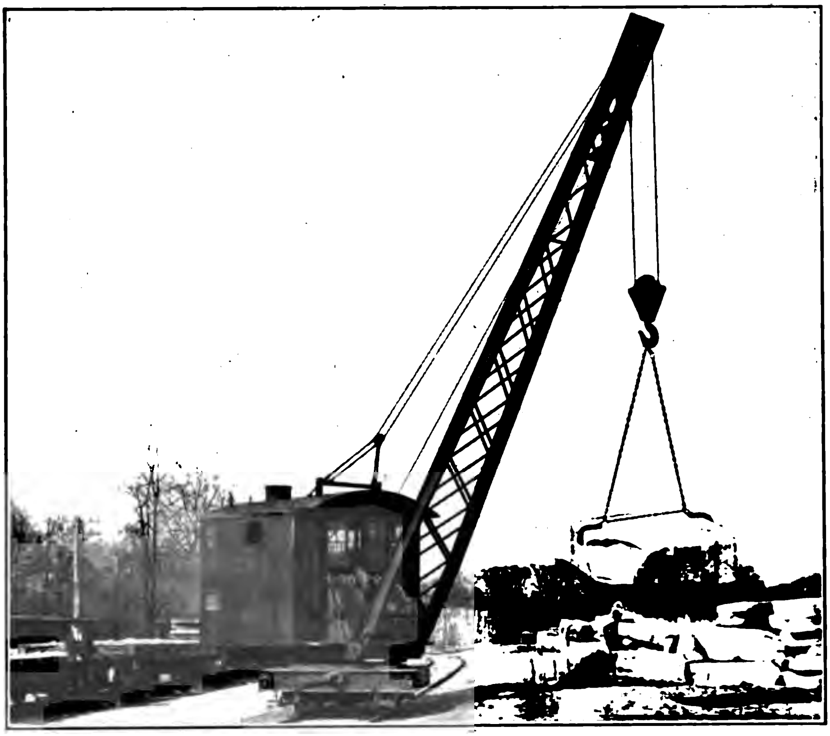


Fig. 2—Handling stone with Browning Locomotive Crane in the yards of Cleveland Stone Co.

for loading and unloading rails, large girders and bridge construction on the German and other European railways. This locomotive crane was constructed at the locomotive works of A. Borsig, at Berlin-Tegel. It includes a 4 coupled tank locomotive with two trailing wheels, the crane being mounted over the cab and operating in a complete circle with a radius exceeding the length of the entire locomotive.

This crane is operated by the steam from the locomotive boiler and the whole equipment is under the control of the engineer in the cab.

Fig. 6—German Crane on a Tank Locomotive.

Locomotive cranes are sometimes operated by compressed air, more frequently by steam or electricity. The latter being largely used on tracks on wharves as well as in the yards of manufacturing plants, while the steam driven locomotive cranes are more extensively employed for railway service in erecting bridges, construction of railroads, loading and unloading cars, and for wrecking service.

The electric locomotive crane is particularly desirable on account of the simplicity and efficiency of the electric motor, the automatic operation of the solenoid brakes, as well as the reduction of liability to accident and the labor saving in control and operations by the attendant.

Fig. 3—Electrically driven crane handling large castings.
Brown Hoisting Machinery Co., Cleveland.

Alternating current motors of the three phase type are now being utilized extensively for the operation of locomotive cranes on account of their recent development with large starting torque obtainable as with the direct current motor of the series type. The alternating current motor is free from commutator troubles, which is largely in its favor as a hoisting motor, while it is now protected so as to withstand a large percentage of overload.

For coaling purposes the locomotive crane is particularly valuable as well as for handling ashes, as the coal is transferred directly into the

engine tender, in coaling locomotives by means of a clam shell bucket and thus several handlings of the coal is avoided. For removing ashes from gondola cars the clam shell bucket operated by the locomotive crane is able to remove all but about 10 per cent of this material from the car without hand labor. The operator in the crane opening and closing the

Fig. 4—Crane of McMyler Mfg. Co. make, equipped with grab bucket for handling coal.

bucket at will, as well as controlling the motions of traveling, hoisting and slowing with accuracy and dispatch.

These locomotive cranes are also employed for unloading cars of coal and placing the same in storage bins, the buckets holding more than 50 cu. ft. and handling from a ton to a ton and a half at each trip, with

an average of more than 50 trips per hour. In this work one man is required to guide the bucket to the car and one operator for the crane and it is claimed that the cost of operation does not exceed about one and a half cents per ton, handling 500 tons per day, this amount including cost of maintenance, oil, fuel and labor.

Fig. 5—End view of German crane.

The locomotive crane is also employed to advantage in iron and steel plants for handling large castings, moving of ladles, ore cars, and handling other material utilized in iron and steel making.

more pessimistic than the state of business justified. It is evidence, also, that the interests which are directly in the storm center have prepared for worse weather than they have been called upon to face. When stock exchange houses are able to go through the ordeal of the last fortnight without flinching, what reason can there be for doubting the security and stability of productive industries and commercial concerns much farther from the seat of trouble?

The way Wall street has stood the strain of extreme depression in stocks has surprised the country. It reflects the general stability of business and the financial strength of the richest nation in the world.

Creating Land by Drainage.

One hundred and fifty million acres is the approximate area of the waste lands in the United States which are possible of reclamation and of being brought into a state of extraordinary fertility and productiveness. They afford about equal opportunity for the two classes of improvement, irrigation and drainage.

If anything, drainage should be the more popular and the more beneficent, for the reasons, first, that the swamp areas are generally in the midst of a more or less populous territory, with transportation facilities already developed; and, second, that the engineering problems involved are comparatively simple and the cost of reclamation is much lower than by irrigation.

The average cost of irrigation reclamation thus far undertaken by the government amounts to about $30 an acre. The cost of drainage reclamation will not exceed, according to official estimates for most of the projects, $5 or $6 an acre; such reclaimed lands will compare favorably with the best cultivated lands in the east, and should eventually reach a value ranging from $50 to $200 an acre, based upon the present value of lands which have already been drained and farmed. —*World of Today.*

Railway Mileage and Earnings.

Poor's Manual for 1907, just issued, is instructive on the point of the reasonableness of average American railway rates. The completed mileage at the beginning of 1907 was 222,635 miles, an increase of 5,294 miles over the previous year. The average receipts a passenger carried was 2.011 cents a mile, against 2.028 the year before—an appreciable decrease. The average freight revenue a ton a mile was 766-1000 of a cent, as against 784-1000 in 1905. The average interest rate on railway bonds in 1906 was 3.99 per cent., and the average dividend on all stock was 3.63 per cent. These returns are smaller than are expected on capital invested in most kinds of business. The total liabilities of all railways in the United States were $17,534,381,633, of which $7,851,107,778 was bonds and $7,106,408,976 was stock. There were other bond obligations and accrued liabilities of various kinds exceeding $1,500,000,000. Gross earnings were $2,346,640,286; net, $790,187,712. The passenger earnings were $1,231,377; freight, $1,659,925,643; other, $165,483,306. The operating expenses were $1,556,452,574. The number of passengers carried was 815,774,118, and the passenger mileage was 25,842,462,029, and the freight mileage 216,653,795,696.—*Baltimore Sun.*

No Corporation Suicide.

The more the country considers the full import of the President's declaration (in his Plymouth speech) that there shall be no retreat, while he is in office, from the position taken by the United States government in regard to the prosecution of law-breaking corporations, the less cause will be discovered for business uneasiness, even in Wall street.

Secretary Taft's speech at Columbus, O., shows that the most promising candidate for the Presidency is determined to carry on the same policy, in respect to the punishment of lawlessness, which has marked the course of the government for the last few years. Obviously, the greatest financial, commercial and industrial interests of the country will have to shape their course accordingly. They must meet the conditions which they cannot change.

The offending corporations will do it. They are not going to commit suicide. That is not their business. It isn't their nature. When they realize that all of the laws of the nation must be obeyed all of the time, in good faith, they will adjust their affairs to meet the necessities of the times. And they will not find it difficult to do this without overstepping the limits fixed by the statutes.

No party, no man, could long flourish in public life by denying plain justice to corpora-

the government is willing to pay a big price for the use of a patent which solves this problem.

The postoffice authorities are also looking out for a good substitute for jute twine. In every postoffice in the country letters are wrapped up and tied with twine on being made ready for delivery. The government has to pay out hundreds of thousands of dollars a year for this cord.

All kinds of substitutes have been offered, but none have proved entirely satisfactory. A great many inventors have made devices for bundling up the letters, but they have all failed before the test of quickly untying them.

A good fastener which can be disposed of instantly, and at a cost less than twine, will be worth a million to the inventor. Whatever this device may be, it will have to be of stuff that can be severed as quickly as a snap of the scissors on twine, for time in the handling of mail counts.

Less haste would obviate much of this waste, the strenuous life of the American people lead to the loss of thousands of lives and millions of dollars.

The saying "the times and the people demand rapid service" is common but wrong applied, for there are a few fool men who think they should be in a certain place before they decided to start. It is to be regretted these were ever born or were not killed in some of the wrecks that their haste demands on the railroads has caused. Truly we do not want the means of our grandfathers or the improvements of a quarter of a century ago, but we want and must have safety. If town and city councils will cut the railroads to a speed of 15 or 20 miles an hour past the station there would be little need of damaging mail bags and the apparatus needed to handle them.

Cost of Alcohol.

With reference to the cost of the production of grain alcohol, the following points were brought out before the committee of Congress, the data being obtained from the books of a large distillery in Peoria, Ill:—

The average price paid for corn for ten years was 42.36 cents per bushel; the average amount of alcohol from a bushel of corn was 4.76 proof gallons (50 per cent.); the average cost of a proof gallon was 10.78 cents. The cost for corn for one proof gallon was 8.89 cents; subtracting this 8.89 from the total cost, 10.78, there is left 1.89 cents as the cost of making one proof gallon of alcohol. At this rate it would cost 3.4 cents per gallon to make 90 per cent. alcohol, or a total cost of 19.4 cents per gallon, including the corn. Lately the methods for producing alcohol have been improved so that about 5 proof gallons can be made from one bushel of corn, or the total cost of a gallon of 90 per cent alcohol is 18.4 cents.

With reference to the amount of alcohol that may be produced from corn and potatoes, Secretary Wilson, of the Department of Agriculture, said that one acre will produce (average) 50 bushels of corn, from which there can be made 882 pounds of absolute alcohol, or about 130 gallons, which corresponds to about 140 gallons of 95 per cent. alcohol. One acre will produce 18,000 pounds of potatoes, from which 1620 pounds of absolute alcohol, or 255 gallons of 95 per cent. alcohol, can be made.

Before the same committee a representative of farmers' organizations said that with corn at 30 cents a bushel, yielding 2.5 gallons of 95 per cent. alcohol, the total cost of making one gallon would be about 12 cents a gallon, and could be sold for 20 cents a gallon.

An enormous amount of starchy material goes to waste annually in the stalks of the corn, i. e., in the plant itself, which in most cases is not removed from the land. With commercially practical methods for recovering and utilizing this waste, the production of alcohol per acre of corn can be greatly increased. The Department of Agriculture has been making experiments, using corn cobs and stalks for making alcohol; it is believed that this will develop into an industry of considerable commercial importance. These materials have heretofore been allowed to go to waste. Experiments made at Hoopeston, Ill., in the corn district of that State, have shown that sufficient alcohol can be recovered from these raw materials to justify the erection of a distilling plant. According to reports, eleven gallons of alcohol have been obtained from a ton of green cobs, while a ton of green stalks yielded six gallons.

Another important source of alcohol is the low grades of molasses, those grades that cannot be sold as molasses. In Central and Southern America and the West Indies there are produced annually millions of gallons of

low-grade molasses, which at present are burned, destroyed or fed to animals; a small proportion is brought to the United States to be worked up into liquors. While this material is much cheaper than corn as a source of alcohol, it produces an alcohol which is unfit for making beverages on account of the odor and taste which it derives from the molasses. But for industrial purposes where this alcohol can be used tax-free this odor and taste are no objections. On account of its cheapness, this molasses is considered by some as the most important source of alcohol at present not developed.

In Cuba alcohol is now made from this molasses at a cost of 10 cents per gallon, according to a report of United States Minister Squires. In the United States this molasses can be bought for 3 cents per gallon, and it takes about two gallons to make a gallon of alcohol; with a cost of 3.4 cents per gallon for making, 90 per cent, alcohol from this source would cost 9.4 cents to produce.

Another source of alcohol is the low-grade molasses produced in the manufacture of sugar from beets. Ten factories in the State of Michigan produced enough of this molasses which was converted into 1,000,000 proof gallons of alcohol in a distillery in that State. While at present the beet sugar industry is still in its infancy, it is obvious that with its development this will furnish a by-product of importance in the alcohol industry.—Gas Power.

INDUSTRIAL PROGRESS

Pacific Coast Letter.

BY J. M. BALTIMORE.

NEVER in the history of the Pacific Coast have there been such activities as now prevail in the way of new railway construction. Especially is this true in the State of California. One of the greatest railroad enterprises is that of the Western Pacific (the Gould System) which corporation is now crowding forward its Transcontinental line between Salt Lake and San Francisco. At present, that company is employing about 9,000 men on this great work—including graders, tunnel workers, tracklayers, bridge builders, etc.

Tracklaying has been in progress for some time in Western California, and the work is being crowded forward with all possible vigor. A large force of men are now laying track between Stockton and Sacramento. This work is being supplemented by a large and powerful tracklaying machine. This machine, under favorable conditions will lay from 4,000 feet to a mile per day, employing from 90 to 100 men. With the aid of this new appliance the work goes steadily and rapidly forward. Very soon the Western Pacific expect to have several tracklaying machines in active operation at different points along the stretch of road in Utah, Nevada and Eastern California. These machines are wonderful savers of manual labor. The accompanying picture shows one of these tracklaying machines in operation on the line between Stockton and Sacramento.

According to the most authentic statement, compiled from actual figures, the quantities of building material that have arrived at San Francisco, Cal., for the fiscal year ending June 30, 1907, are really stupendous. These figures have been very recently compiled by

Track laying machine.

ings, or loads, as glass is packed, for nearly 200 large cars. This means about five solid train loads of window glass alone.

In considering the above figures, the fact should not be overlooked that all these enormous quantities of building material only represent what was shipped in bottoms. The amounts would swell to colossal proportions if only the quantities brought by rail were added.

Work on the new electric power and light station at Redondo, California, is progressing rapidly, and these immense works will soon be completed and in operation. These works are being constructed by the Pacific Light and Power Company, of Los Angeles, at a total outlay of $1,500,000, and, when finished, will be the greatest plant on the Pacific Coast.

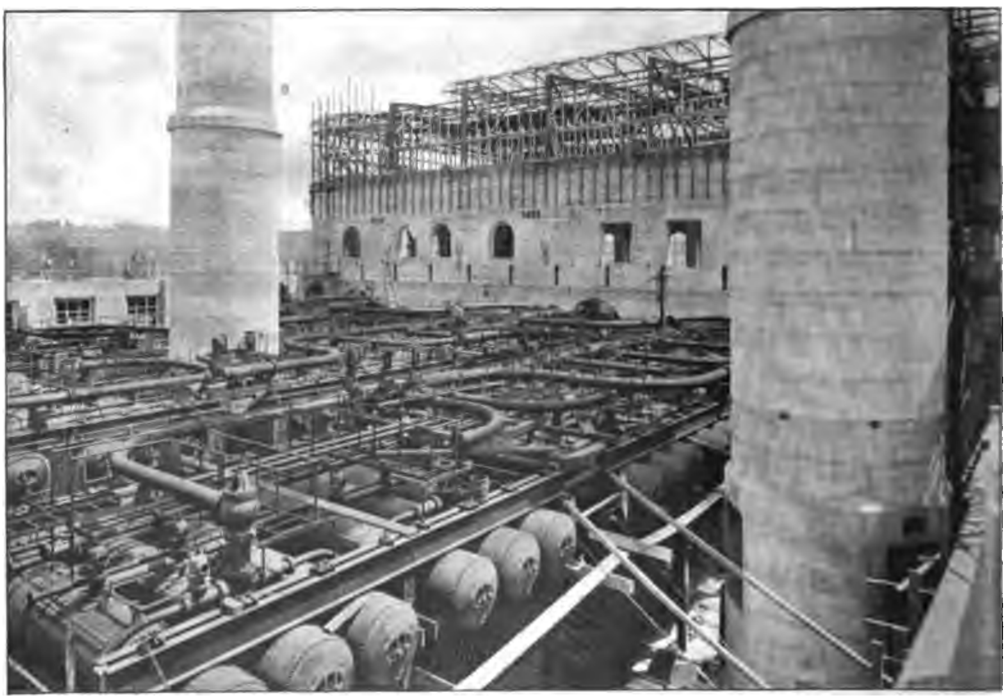
This power plant has been truthfully called a "Giant of Cement," for that material has been used very extensively in the construction of these immense works. Mr. Carl Leonardt, one of the leading cement contractors of Southern California, has the contract for constructing the great plant, and E. S. Cobb is the chief engineer in charge.

This plant will be capable of generating 25,000 horse-power, and, in case of emergency, can furnish an additional 25 per cent of efficiency, which makes the possible output about 30,000 horse-power.

The building which will house the powerful machinery is the largest reinforced concrete structure on the Pacific Coast. More than 28,000 barrels of cement have been used. In the construction of this massive building, unique plans have been followed out. The foundation necessary for the giant engines which will drive the generators, and sustain the constant vibration are enormous.

One concrete slab alone measures over 138 feet long by 63 feet wide, and is 6 feet thick. This is but the "Sole" upon which the foundation, proper, of the engines rest. It contains a total of 2,000 cubic yards of concrete, though only the beginning of the foundation. About this slab towers for 14 feet a second foundation of concrete reenforced with twisted bars of steel. Upon this solid, rock-like formation, rest the engines.

The suspicion with which cement has been regarded by the contractors of Los Angeles since the recent Bixby Hotel disaster has caused Contractor Carl Leonardt to subject



View of the Engine Room, the Electric Generators, etc.

One of the largest pieces of work that has been accomplished ih California during the past year is the immense petroleum refineries which have been erected, and just installed, at Oilport, near Port Harford. The total cost of these huge refineries approximates $1,500,000 and were paid for by San Francisco and London capital. These refineries are now in operation and, in a very short time, will be in full blast. More than 14 months were consumed in the construction of these great works. This is the largest independent refinery in the West.

This new plant is one of the few in the United States not under the dominion of the Standard Oil company, and it possesses a natural advantage in being on the coast and is in a position to withstand the onslaughts of the Rockefeller interests. Its natural position also makes it immune from the usual rebate tactics, and, on the whole, but little fear is felt from Standard Oil sources. The general impression is that the latter concern does not mind proper competition—when it cannot help itself.

The enterprise is the result of the oil discoveries in the Santa Marie field. Following the find of the Union Oil company, the Graciosa Oil Company, of San Francisco, began drilling. After going down over 1800 feet without making a strike, some of the shareholders wished to cease operations. However, the work was actively pushed ahead and, at a depth of 3000 feet a big and steady flow of oil was struck. Then the company went forward and erected its immense works.

Among the first coups of the new company was the obtaining of valuable contracts with Japanese steamship interests. The Rockefeller people made a vigorous fight for these big contracts, but the California company succeeded in winning out. The details of this immense Oriental contract are not known, but it is a very large one. In the future, a great many of the Japanese steamships will obtain all of the needed oil from the new California company.

Large delivery stations are soon to be erected in San Francisco, and it will be possible for steamers to load and take on their fuel in San Francisco, as well as at Oilport.

Some idea may be formed of the size and extent of the plant when the fact is stated that 2000 tons of cement were required and that over 3,000,000 brick were used in the construction of these works, besides, a great deal of other kinds of material—structural steel, etc.

The pipeline running from the oil fields to the refinery is 38 miles long, and the flow is entirely by gravitation. The wharf in connection with the plant is 2200 feet long. The plant is capable of producing 8000 barrels a day and at the outset will support 150 families.

The first cargo bound for the Orient has already been shipped. This, however, is but the inception of the vast trade with the Far East which is to follow, as the people of the Orient are awakening to the uses of oil. As soon as conditions warrant, the California Company will enlarge its already immense plant.

President E. H. Harriman, of the Southern Pacific, has for sometime past, been planning to carry into active effect an immense electrical enterprise in connection with the operation of his trains in the Sierra Nevada mountains. His plan is to develop an immense electric power transmission plant up in the mountains.

One of the principal objects of this enormous plant is to supply electric power with which to operate his heavy passenger and freight trains over the very heavy mountain grades. His engineers have been figuring for some time on the project and they estimate that adequate electrical power can be created with which to operate all the Southern Pacific trains on the mountain division at a much cheaper rate than at present by steam.

This electrical scheme will not be carried into active operation until after the completion of the great six-mile tunnel that the Southern Pacific will bore through the mountains a short distance west of Trucker. This great tunnel wll be over 36,000 feet long and engineers estimate its total cost at $12,000,000. It will be the longest railway tunnel on the continent and more than three years will be required to complete the vast undertaking. This great tunnel will cut down the distance considerably and will almost entirely eliminate some heavy grades on that part of the road. All the surveys for this giant tunnel have been completed and it is the purpose of the Southern Pacific to commence active operation soon.

When the tunnel is completed all trains will be operated by electric power between Sacra-

The Western Pacific has just commenced the very extensive work upon its big series of river and creek bridges. There are 75 bridges to be built along the 929 mile road between San Francisco and Salt Lake City; but all of them west of Wells, Nevada, which is a town 700 miles from San Francisco, and the location of the last bridge to the eastward.

Wells is near the head of the Humboldt river, which the Western Pacific will have to bridge no less than 33 times. But, after passing Wells, and, on eastward to Salt Lake, a run of 229 miles, there will not be even one bridge on the road.

These 75 railway bridges make an aggregate length of almost three miles and the Western Pacific engineers say they will require the enormous total of 20,000 tons of structural steel. An order for 2,000 tons has just been placed in the East. The location and length of just the principal bridges are:

Mokelumne bridge, 162 feet; Cosumnes, 200; American, 560; Yuba, 400; Middle Fork Feather River, 442; North Fork Feather river, 448; North Fork Feather river, 260; Chandler Creek, 640; Willow Creek, 1000.

Chandler Creek, away up in the wilderness of the mountain slopes, is really to be crossed by a trestle instead of a standard bridge. The trestle is to be built on six steel towers—70, 105, 110, 80 and 40 feet high, and across the level top of these towers there will be six spans of 60 feet each, two spans of 50 feet each, and six spans of 30 feet each.

Willow Creek, a tributary of the Feather river, still farther up the Sierra slopes, is to be spanned near the little town of Clairville, with a structure resting on ten steel towers—65, 80, 110, 150, 165, 165, 150, 110, 80 and 45 feet high, and covered by eleven spans of 60 feet each, four spans of 40 feet each and six spans of 30 feet each.

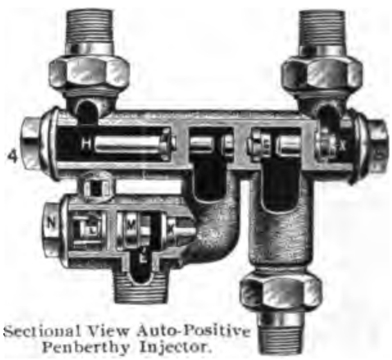
As yet, not a single bridge has been built by the Western Pacific, but this great work has just been commenced and will be rushed through with all possible speed to the end. The work will be crowded just as rapidly as money, material and men can be secured. As the road is to be completed within two years it will be necessary to rush all of the bridge work with the utmost haste. The 33 bridges across the Humboldt river, in Nevada, will all range from 125 to 150 feet in length.

The construction of these three miles of bridges will be the largest and most expensive similar work ever undertaken previously by any Western railway company. The total cost it is estimated will aggregate not less than $1,000-000. All the contracts for bridging have been awarded at the company's head office, New York.

Injector for Hot Water.

WHILE a large majority of boilers carry less than 150 pounds pressure, the usual high working pressure of the ordinary automatic injector, there is an increased demand for an injector operating between 150 and 200 pounds pressure. There is also a demand for an injector that will handle a water supply that has become heated by use of the syphon (or ejector) and in other ways and is consequently too hot for injectors of the usual automatic type.

In feeding a boiler with water over 120 degrees Fahr. many users of steam experience a great deal of difficulty due largely to their failure to meet the necessary conditions. Consideration must be given to the fact that at a certain point on high steam pressure the



Sectional View Auto-Positive Penberthy Injector.

condensing qualities of the water are not sufficient. Steam must be condensed before it can pass through the injector. For instance, at 180 pounds steam pressure, the same volume of feed water will not condense the steam that would be sufficient to condense the steam at 120 pounds pressure. The higher the temperature of the feed water the less are its condensing qualities and vice versa.

This injector differs materially from any other automatic injector ever before placed on the market, being constructed on new principles, *having but five working parts* and combining the features of a positive with those of an automatic injector. By this combination it is enabled to handle much hotter water and work on higher steam pressure than any other automatic injector. This is built by the Penberthy Injector Co., Detroit, Mich.

Like the Baltimore & Ohio engines, these engines are designed for pusher service. They will operate between Susquehanna and Gulf Summit where the ruling grade is 1.3 per cent. In working order they have a total weight of —— pounds, all of which is on the driving-wheels—there being 8 coupled wheels in each group. Considering the fact that the average load per axle of 50,200 pounds is less than that of many road engines of the present day, the advantage of this type for obtaining a maximum adhesion for tractive power with a minimum rail pressure per wheel is clearly shown. The boiler which is shown in the accompanying illustration is the largest locomotive boiler ever built. It is of the radial stayed type with conical connection, the inside diameter of the first or smallest course being 82 inches, while the inside diameter of the largest course is 96 inches. The heaviest ring of the shell is 1 3-16 inches thick. The water alone in the boiler weighs 42,700 pounds, and the tubes, of which there are 404 in number, 2¼ inches outside diameter and 21 feet long, weigh 23,700 pounds. The firebox is of the wooten type, 120⅛ inches long and 114¼ inches wide, and has a grate area of 100 square feet. The water space at the mud ring is 5 inches on all sides. As will be seen from the illustration, the boiler is provided with a combustion chamber 4 feet long, which is radially stayed to the shell of the boiler.

As these engines will work as much backward as forward, it was necessary to locate the dome as near the center of the boiler as possible. The dome, therefore, which is of cast steel, has been placed on the top of the conical course. The throttle, which is clearly shown in the accompanying drawing, acts also as a steam dryer. Steam is admitted through the top only and the water entrained strikes against the walls of the special shaped casting covering the top of the throttle pipe, and as is the tendency of water under pressure, follows the surface of this casting and passes down through the center of the valve instead of going into the dry pipe. Steam is led from the throttle pipe through a short dry pipe to a point directly in line with the high pressure cylinders, from whence it passes through the top of the shell and is divided in a tee-pipe and passes down through wrought iron steam pipes on either side of the boiler to each of the high pressure valve chambers. The design of the high pressure cylinders which is shown in the accompanying illustration is similar to that used on the Baltimore & Ohio engines, the cylinders being cast in pairs with saddles, and the separation between the two cylinders being 8½ inches to the right of the center line of the saddle, to make room for the receiver pipe. The engines are compounded on the Mellin system, the intercepting valve being located in the upper part of the left cylinder casting. Exhaust steam from the right high pressure cylinder passes through a cored passage to the back of the cylinder casting, from whence it passes through an outside U-shaped pipe connecting to a passage in the left cylinder casting leading up into the intercepting valve chamber into which the exhaust steam from the left high pressure cylinder also passes. The emergency exhaust valve is located in the side of the left cylinder cast ing and has a 4½ inch jointed pipe connection with an opening in the back of the exhaust pipe in the smoke box. A three way cock within easy reach of the engineer operates the emergency exhaust valve.

Steam from the high pressure cylinders passes into a 9 inch receiver pipe extending forward from the center of the cylinder saddle to which it is connected by means of a ball joint. In order to facilitate putting in place or removing, this pipe is made up of three sections, and is connected at the front end by means of a slip joint to cover variations in length due to curving to a Y pipe through which steam reaches each of the low pressure steam chests. The receiver pipe is laid out for 16° curves. The flexible connections are the same as those used in the Baltimore & Ohio design, which have proven so satisfactory—no trouble from leaky joints having been experienced throughout the entire two years this engine has been in service. Steam from the low pressure cylinders, which are located considerably ahead of the front end of the boiler, exhausts back through a flexible pipe connection to the exhaust pipe in the smokebox. The high pressure cylinders are equipped with piston valves, and the low pressure cylinders with Richardson slide valves. The valve gear is, of course, of the Walschaert type. By an ingenious arrangement of the reversing gear, the weights of the valve motions of the front and rear engines counterbalance each other. The erecting card clearly shows the arrangement. As the high pressure valves are internal admission and the low pressure external admission, it was possible with this arrangement of reversing gear to obtain a most satisfactory

separated; the entire mass commingles during the process of mixing, assuring uniform concrete of the highest order, both as to the proportioning of the finer and coarser materials and the even distribution of the cement.

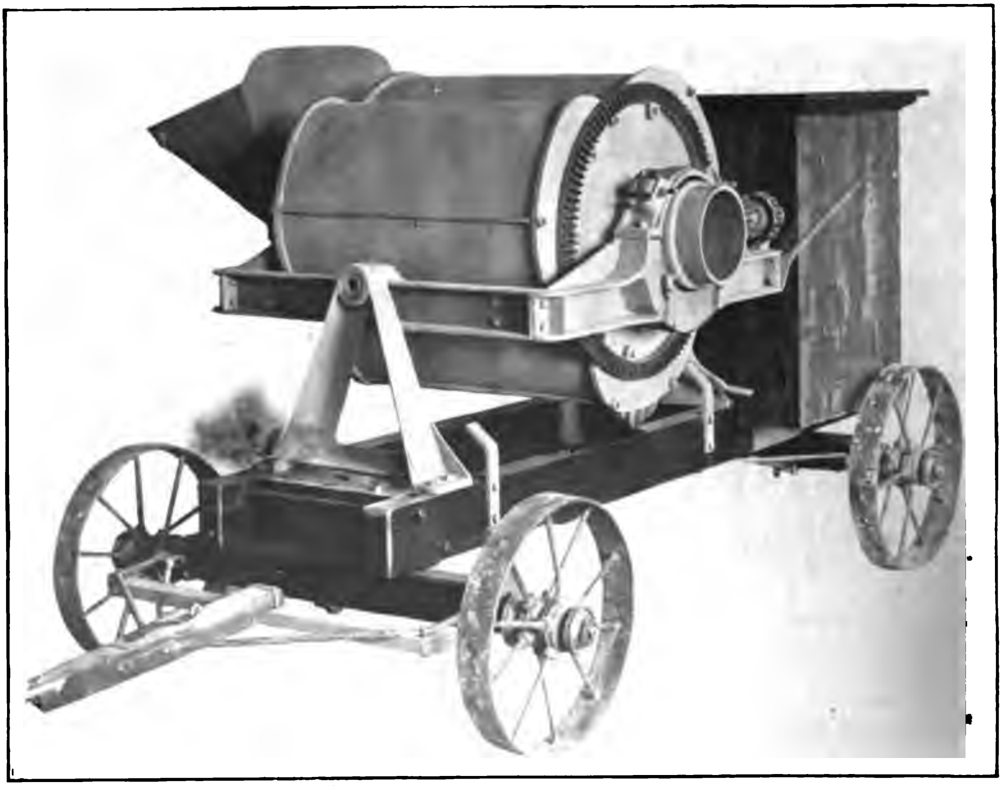
It is guaranteed not to ball or roll the concrete, and that it positively doubles over and scatters every atom of the mass each time of the passing up of the angle.

The unique form of the mixing receptacle of the Clover Leaf Concrete Mixer insures a full and complete intermixing of the mass without the aid of appliances or mechanism of any description. The curves or angles of the drum positively double over the greater portion of the mass, the top going to the bottom and the bottom to the top, while the remainder is carried up by the same angles, aided by the centrifugal force of the machine, effectively distributing same the full width of the machine and over the portion previously doubled over, giving practically six distributions to the mass every revolution, allowing from 80 to 90 distributions per minute.

The mixing receptacle is oscillated from end to end twice each way each revolution of the machine, or from 50 to 60 end to end movements per minute. These end to end movements, together with the doubling over and carrying across of the concrete by the direct action of the machine, assures a most positive and thorough intermixing of the mass, and that in the minimum time.

Having disposed of the Chicago drainage canal question and the international boundary line on Lake Erie, the International Waterways Commission will next take up the old question of damming the lower end of Lake Erie so as to raise the level of the lake.

Lake marine interests have been urging the matter for a long time, and it is understood that the commission at its last session decided to take up the problem next month. While no definite plan has been submitted to the commission the general scheme in view is to build a great dam or regulating work at the lower end of Lake Erie or somewhere in the Niagara River.



No. 8 Mixer with gasoline engine on trucks.

of the pockets or hoppers. All of these hoppers are provided with outlets about three feet square for delivering the coal from these pockets on to the conveyor, which travels the entire length of the hoppers and on the bottom of the scow. This conveyor consists of two strands of very heavy chain, to which is fastened flights which convey the coal as it is delivered from the hoppers to the end of the conveyor, where it is conveyed up a short incline and delivered into an elevator. The main body of this elevator consists of sheet iron plate, to which is fastened angles, which form the guides for the chain. There are also two strands of heavy chain in this elevator to which are fastened buckets, centrally hung, and which take the coal as it leaves the conveyor and elevates it up and delivers it into a centrally located hopper, mounted on a turntable. Im-

This is a rear view of the upper end of the loading chute. It shows the construction of the adjustable trimmer.

mediately under this hopper is the lower end of an inclined elevator. This elevator is arranged so that the outer end can be raised or lowered so that it will deliver coal to the vessels to be fueled at any angle from the horizontal to 45 degrees. To the upper end of this inclined elevator is attached a telescope spout. This telescope spout is so arranged that it can be swung out or in to accommodate itself to the hatch of the boat which is being loaded and also raised and lowered as may be desired.

The motive power for this inclined elevator is derived from a double cylinder engine of sufficient capacity which is located on top of the turntable. This engine also operates the telescope spout and furnishes power for turning this turntable by means of whch the inclined elevator can be turned to fuel the boats on either side of the scow. There is also provided a double cylinder engine of sufficient power which is mounted on the deck of the scow for operating the conveyor and elevator. Both engines are supplied from a boiler situated on the deck of the scow. Everything is made extra strong, being especially designed for the work it is intended to do.

The scow fuels boats only and takes care of the entire harbor. Sometimes it is kept busy day and night. It has a capacity of from 250 to 300 tons per hour. The cost of repairs is light. The cost of handling the coal probably does not exceed 16 cents per ton. 175,000 tons of coal were handled during 1906 and it is expected to do better this year.

Suitability of Lubricants.

THE requirements of a good lubricant are commonly stated as follows:—

1. Sufficient "body" to keep the surfaces apart under conditions of maximum pressure.

2. The greatest possible fluidity consistent with No. 1.

3. The lowest possible coefficient of friction in actual service.

4. Maximum capacity for absorbing and carrying off heat.

5. Freedom from any tendency to oxidize or gum.

6. Absence of acid or other corrosive ingredients and freedom from gritty matter.

7. A high "flash point," or temperature of vaporization and a low congealing or "freezing point."

8. Thurston in Friction and Lost Work includes one more specification. He requires that there shall be "special adaptation to the conditions as to speed and pressure of rubbing surfaces, under which the unguent is to be used. The purpose of the present remarks is to explain in some detail the significance of this last requirement, which is so often overlooked.

It is not taking too great a liberty to assume that the products of any reputable maker of lubricants may be accepted without fear of their containing grit or corrosive acid, or of their having a large content of gumming or oxidizing oils. Mineral oils are well free from any tendency to gum though tallow greases have often been observed to have gummy deposits in bearings, perhaps due to

[illegible] of soaps or decomposition of fats. As [illegible] flash points and freezing points, any engineer [illegible] make a reasonably accurate estimate of [illegible] without trouble. Sufficient "body" is evi[illegible] if a bearing will not run hot under a lubri[illegible]. This leaves three requirements to be [illegible]ssed—the greatest possible fluidity, low[illegible] possible frictional coefficient and this mat[illegible] of adaptability. The only possible way to [illegible]mine how thin an oil may be used is to [illegible] *it and see*. The thinner the oil or grease, [illegible] less its "viscosity" or "body," and the less [illegible] its presence retard the motion of the [illegible]cated surfaces. If a layer of lubricant [illegible]terposed between two metal surfaces and [illegible] enough to completely separate them, [illegible] of the different particle or layer of [illegible]bricant one upon another—the fluid fric[illegible] or internal friction of the lubricant as it [illegible]en called, represents the frictional loss. It [illegible] evident that to keep a given bearing as cool [illegible] possible, there must be an adjustment of [illegible] and *fluidity*.

Closely related to these requirements is [illegible] quality of suitability or adaptability. Ac[illegible]ly every bearing presents certain differences [illegible] every other bearing, even similar ones, albeit these differences are often microscopic. Theoretically every bearing requires separate consideration and the selection of an oil or grease that will give the best results; practically, this would be ridiculous, but there is a limit beyond which this grouping of bearings and lubricating each group with a certain oil, may be carried at a sacrifice of economy. Only careful study will determine how few different lubricants should be kept on hand to reduce friction to the lowest.

While it is of prime importance to prevent overheating, wear and tear and failure due to lack of proper lubrication, it is fair to assume these things as accomplished in any well-regulated plant or factory.

The great purpose of lubrication is to prevent friction, and it is a matter of common knowledge that heating means excessive friction. Few realize, however, that even bearings developing considerable friction may not heat up; a copious supply of oil carries off the frictional heat so that it does not appear. But all that friction means lost power and fuel and increased wear. Hence the importance of this matter of suitability. Just because an oil or a grease keeps a bearing reasonably

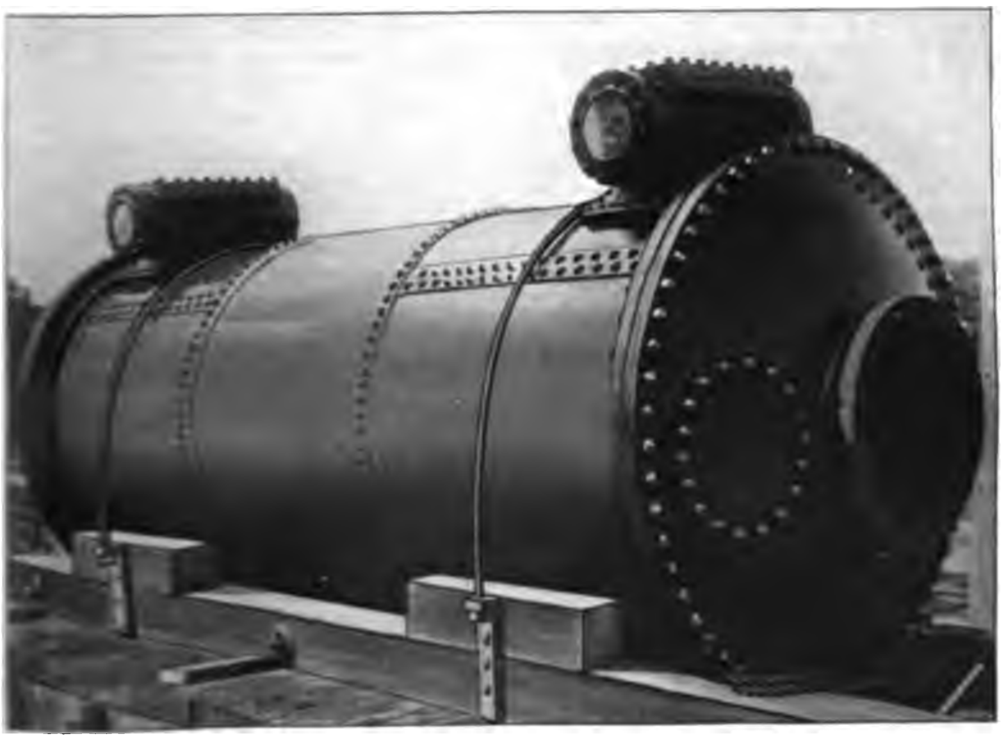


Fig. 1 A 600 H. P. Primary Heater at Kingsbridge Power House

cool is not final proof that there is not another lubricant with which it will run even cooler. Some bearings run perfectly cool on grease, but there is abundant evidence that grease-lubricated bearings consume more power than the same surfaces lubricated with oil, the explanation being the greater viscosity of the grease. There is, however, a class of lubricants known as non-fluid oils in which the cleanliness of grease has been attained without the objectionable increase in viscosity —hence without the retarding action so frequently reported in the case of grease-lubricated machinery.

Suitability means more than the mere selection of a lubricant that will keep the friction at the lowest possible point. It often happens that there are other considerations far more important than friction and usually these are related either to the means of or opportunity for applying the lubricant, or to the difficulties and damage arising from the presence of oil on floors, wells, goods in process of manufacture, etc. In such cases, cleanliness must first be attained, and after that low friction, or else the lubricant is not suitable. There are many of these special applications where the general rules and fundamental principles have to be set aside for reasons of still greater importance. Sometimes, in cases when the oil stains must be avoided, animal oils are employed because of the ease with which they can be washed out compared with mineral oils. Sometimes greases are used with a measure of success. Non-fluid oils cover cases of the sort mentioned, and the degree to which they are rendered non-fluid is governed by the requirements of the case. It is possible to obtain almost any density or body.

Perhaps the main thought to be emphasized in discussing the matter of suitability of lubricants is for the user or buyer not to rest satisfied with a lubricant until he has studied the matter out with scrupulous care from every point of view.

The cost of lubrication is not merely the cost of the lubricant, but the cost of labor, repairs, damage (if any) and friction accompanying its use. To be able to reduce friction two or three per cent. in a plant of any size will pay for difference between the cheapest lubricants and the dearest, many times over. To lessen a fire risk or damage to manufactured goods through dripping and spattering oil it is well worth while to spend time and trouble finding the right lubricant that combines drip-loss properties with low friction. To the man who simply knows that oil is oil, and grease is grease and, as long as you get enough of either on a bearing and have no trouble, all is well, these remarks have no direct message, unless to help open his eyes to greater possibilties.

To the engineer who is anxious to show results and to "stop leaks" everywhere he can, the writer's earnest advice is not to rest from experiment and trial until he had found truly suitable lubricants for the machinery under his care, and proved their suitability.

Fig. 2—View into end of heater when cover is removed.

Unique Primary Heater.

The accompanying illustrations, Figures 1, 2 and 3, show the construction of one of the 6000 horsepower primary feed water heaters installed at the King's Bridge power house. There are three of these heaters having a total capacity of 18,000 horsepower, each measuring a trifle less than 16 feet in length and 66

Fig. 3—Water Connection of Heater showing External Cast Steel Header into which core ends are expanded.

The steam shovel and derrick attachment to an Avery traction engine with tender.

to another, and where a large amount of this work is being done continually, one of these machines should be a great time and money saver.

The tender is of a new style, much stronger than the usual engine tender, and is carried by an 18-inch faced wheel, and is so attached to the engine, and guided in such a way, that it is always directly behind, whether the locomotive is moving forward or backing up. It has a water capacity of 1 ton and over.

The company also builds heavy steel axle wagons of ten and fifteen tons capacity, which are furnished with or without platforms, and are built especially for coupling on behind this traction engine, and used in hauling lumber, dirt, gravel, sand or ore.

All-Steel Postal Cars.

By Charles Alma Byers.

AT its shops at Sacramento, Cal., the Southern Pacific Railway Company has just turned out, from designs of its own motive power engineers, an all-steel postal car of the most advanced type yet built. With the single exception of window frames, there is not a piece of wood in its entire make-up. It is constructed throughout, from the wheels to the roof, including frame, floor, sides and fittings, of metal—mostly steel.

In building this all-steel car for carrying the mails, which is to be followed immediately by more of the same kind, the Southern Pacific Company is one of the first railway companies to yield to what a large portion of the public has been strongly advocating for several years—the creation of a train of greater and more symmetrical strength. This car is designed by its builders especially for the purposes of being proof against telescoping, of reducing deterioration to a minimum, and of serving, in case of fire, as an unburnable

An Interior View Showing Detail of Side.

A view showing mail handling apparatus in position.

barrier between the locomotive and the coaches. It will also give much greater protection to the postal employees and the contents of the car—features likewise of importance.

The builders of this new style postal car claim that it is capable of withstanding over 200 per cent. more shock than the ordinary wooden creation. To two massive twelve-inch I beams that weigh 31½ pounds per foot, and that take the place of the old postal car's wooden sills, is attributed the larger portion of this increase in strength. The sides and the roof of the car are laid with heavy plates of steel, strongly riveted, and the floor is formed by monolith laid over two courses of corrugated steel.

The car inside is lined with asbestos, while the ceiling, like the outside and the roof, is of steel plates. It is strongly braced in every direction, and to withstand heavy shocks on the end framing a steel plate twenty inches wide is riveted across its top. The entire car is so strongly and thoroughly bound together that telescoping, the builders say, is absolutely impossible. In fact, before yielding in this way it will withstand a shock sufficient in force to buckle the entire frame.

The car is provided with electric and steam heating appliances, automatically regulated, which add still further to its fireproof qualities. All the fittings and apparatus used in handling the mails, designed and built to conform with the requirements of the Railway Mail Service Department, are of steel or brass. In fact, the only inflammable thing in or about the new car will be the mails, and to offset the danger of fire from this source to a great extent fire extinguishers are handily provided.

Besides the Southern Pacific Company's new all-steel car for carrying mails, the Pennsylvania Railroad Company, in its car No. 6,546, possesses a new postal car of all steel that also deserves recognition. The initial trip of this car was made some time ago, between New York and Washington, and at its destination was inspected and heartily approved by the Postmaster General.

A description of this car says that in its make-up there are but 370 pounds of wood—some more than in the Southern Pacific's, but still so little as to leave it entitled to the distinction of being called all-steel. Its total weight is 128,500 pounds, which therefore makes its proportion of wood comparatively small. Of the 128,130 pounds not wood, 2,840 pounds is of fireproof composite and asbestos board, and 3,200 pounds of cement flooring. The latter is laid, in a plastic state, over corrugated iron foundation plates.

A feature about the Pennsylvania Company's car to place it in a position of still greater distinction is found in the fact of its exceeding by ten feet the length of the standard mail car, being 70 feet 8¼ inches long, inside measure, while the standard length is but 60 feet. The outside dimensions are as follows: Length over buffers, 74 feet 9¼ inches; width over roof eaves, 9 feet 11½ inches; height, from top of rail to top of junction box on the roof, 14 feet 5 inches. Other than in the matter of size the two all-steel postal cars are constructed along quite similar lines.

Prior to these introductions of the all-steel creation, the strongest and best made car in use was what is known as the "Universal Postal Car." This is the car that all have grown used to, and has been in service for several years. It is 60 feet long, weighs 110,000 pounds, and is lighted by gas lamps. It has, in a way, been very serviceable, but it has also many fatalities to contents and to human life charged to its account. The new all-steel postal car, which promises to revolutionize the car-building industry, offers protection in this direction that has long been craved. And more, it presents a better general appearance both inside and out than does the wooden car.

A view showing apparatus folded.

An All-Steel Mail Car.

That the all-steel train, including baggage, mail, passenger and Pullman cars, will be the ultimate result of these experiments, and the public's agitation of the subject, is now practically assured. A convention of superintendents of railway motive power was held in Los Angeles, Cal., on September 17th, and this was one of the first subjects discussed. Mr. H. J. Small, of the Southern Pacific Company, delivered a lengthy report on his company's experiments with all-steel coaches, and ended by saying that a solid steel passenger train would be inaugurated on the Harriman lines in the near future, with safety and durability as the aim. He estimated that by such a train the cost of maintenance would be decreased about one-half, which would more than offset the increase in the first cost. He also reviewed the fact that the steel car will withstand a 200 per cent greater shock than the present coach, besides being practically fireproof, and is only slightly heavier in weight.

"It is only a matter of a few years," Mr. Small said in concluding, "until nothing but steel cars will be used. The steel cars which have been in use on the Southern Pacific show much more durability and safety for passenger traffic than the wooden ones. At Sacramento a few steel mail and baggage cars were built last year, and are in use. As fast as possible the wooden cars will be displaced.

"At the Jamestown Exposition the Pullman Company exhibited a fireproof steel car. I understand that the company will put the steel model on the market as fast as possible. It will take some time, however, before an entire steel passenger train will cross the continent."

Mr. Small's remarks were heartily approved by the other superintendents in attendance, and recommendations were made to adopt the all-steel model. It was also pointed out that the steel coal and flat cars in use have cut down the cost of maintenance to a considerable extent, and the model was recommended for adoption in the matter of box cars.

All such moves as these go to show that the railway companies have resolved to cut down the annual list of casualties, and to otherwise perfect railroad traffic. The report of the Interstate Commerce Commission shows that the casualty list of the railroads in the United States for the year ending June, 30, 1907, was larger than in any previous year. During the period 6,818 persons were killed and 97,706 injured. In view of such startling facts it certainly behooves the railway companies to do something to turn the tide in the other direction, and that the all-steel car promises much in that direction can not be questioned.

tenance, by another course in railroad economics, and by a third in design and office work. An advance course in railroad economics is given for graduate students who are candidates for the C. E. degree.

Major Fitch has decided to recommend to Washington for acceptance the bid of the Great Lakes Dredge & Dock Co. for the construction of the rubble mound breakwater at the Superior entry, Duluth.

The part of the bid accepted is that which offers facing stones in position, each stone to weigh not less than ten tons at $1.60 per ton, and core rock on cars, scow or United States dock on the work, at $1.20 per net ton. All rock furnished must be subject to inspection by the government engineers. This is a big job and will take two years or more to complete.

The rubble mound will be outside the piers, running out into the lake. They will converge toward the ends, thus furnishing a stilling basin at the mouth of the harbor.

This style of breakwater is considered an improvement over the old fashioned method of making a breakwater at right angles to the piers and at some distance out from the mouth of the harbor. It remains to be seen the success that will attend the experiment.

News Items.

The Standard Roller Bearing Company, of Philadelphia, Pa., has recently made many large additions to its plant, and now has the largest works of its kind in the world. The buildings extend over ½ mile of ground from end to end, having a floor space of over 500,000 square feet, the concern now employing over 1,500 men.

The business has grown to such proportions as to necessitate the establishing of a thoroughly organized department of publicity. The new department will be conducted by Mr. C. Dickens Sternfels who has been identified in a similar capacity with the Arthur Koppel Company, Pittsburg, Pa., for the past three years.

Mr. Sternfels assumes charge of the Standard Roller Bearing Company's Publicity Department on September 16th, and will be located at Philadelphia, Pa.

The west coast countries of South America are nearly 2,000 miles closer to the manufacturing districts of the United States than they are to the manufacturing districts of Europe.

New West Boston Bridge.

BOSTON to Cambridge. Cost $3,000,000; four middle arches have seals of Boston and Cambridge carved upon them, those of Boston on the Boston side and those of Cambridge on the Cambridge end of the bridge. Bridge brilliantly illuminated by electric lights. Four central towers cost $100,000 each. Piers on which they rest are 200 feet long, 67 feet wide, with height of 100 feet from piling to level of bridge roadway. Bridge is 1,700 feet long and 105 feet wide between the rails. Been under construction since 1900. Exclusive of approaches over 25,000 piles were driven; over 1,500,000 feet of cofferdam work was built while about 85,000 cubic yards of screened gravel and broken stone and 150,000 barrels of cement were used. Over 14,500,000 pounds of steel were used in the superstructure for the Robin Hood's bow arches. Seals cost $6,000 each. Boston and Cambridge share the cost equally.

General view of West Boston Bridge.

Another view of truss and grab bucket.

with the necessary payments of damages for property and other incidental expenditures, will run the total cost of the improvements up nearly to $5,000,000.

Washington, August 24.—With some slight assistance in the form of guesses by Vice President H. B. Spencer, of the Southern Railway, Speaker Justice, of the North Carolina legislature, computed that it costs nearly $54.37 to operate a passenger train of two coaches and a baggage car on the North Carolina railroad from Goldsboro to Greensboro, a distance of 134 miles.

By the same method of deduction the speaker calculated that the revenues from this train would amount to $390, and that the difference would be the profit to the railroad.

He did this to refute the testimony given by Mr. Spencer that it cost an average of $1.03 a train mile to operate a passenger train in the state and that the revenues from the train would average $1.25 per train mile, including mail and express.

Formal announcement has been made of a proposal to build a four-track elevator monorailroad between Newark and Jersey City. The necessary capital has been obtained to finance the undertaking which, it is predicted by Rapid prove the forerunner of radical changes in railroading.

The project will not only have the benefit of the long experience of Mr. Starin, but of Rapid Transit Commissioner Woodbury Langdon and Charles Stewart Smith. The Rapid Transit Commission will go out of existence on July 1 to make way for the Public Service Commission.

It is the announced purpose to make the monorailroad an ideal interurban system. If pending negotiations are successful, connection will be made with the McAdoo tunnels on the Jersey side, but in any event the Monorail company will establish its own line of fast ferryboats which will carry passengers only. The fare from Newark to Jersey City will be 5 cents and from Jersey to New York 3 cents. The scheme is that invented by Howard H. Tunis, a civil engineer of Baltimore.

No end of discussion has been caused by the epidemic of railroad accidents which have occurred during the early part of 1907 and Congress has tried to do something toward their prevention by passing a law limiting the number of hours which a railroad employee may work at one stretch. Many of the accidents can probably be laid to the lack of rest and sleep which has caused men to

shippers. The importance of such a step is so great as to really warrant a protest on the part of every shipping interest of importance in the country. It is a step away from the quick delivery of goods and a step which other railroads are likely to follow because it means increased economy for the transportation company.

"The entire question of railroad methods along this line is fraught with so much interest to the entire shipping interest of the United States that it will bear very careful study by those who are trying to get from the railroads the service which will permit them to conduct their business with some sense of security and with some profit from the operations."

There is a great deal of discussion in railway circles as to the relative merits of wooden and concrete ties. It is said that experiments with the concrete tie have resulted in some cases in complete success, and some roads have pronounced tests a failure.

Two serious objections are advanced against adoption of the new material, one of which is the tendency of concrete to break away from the reinforcement when steel is used, and the second is the trouble in keeping the fastenings in the ties. These conditions might have been anticipated, however, by any one familiar with concrete.

Concrete ties have been used by the Lake Shore & Michigan Southern, the tie used being one of special construction and designed by one of the engineers. These ties have been used in a slow track for about three years and apparently are good for many years' service. Their use in a fast track has been found to be unsatisfactory by this road, and its engineers are of the opinion that they are not suitable for tracks which carry a very heavy traffic at high speed.

This does not mean, however, that they should not be used for yard tracks or any other tracks which carry their traffic, however heavy it may be, at a slow speed. It is the belief of the officials of this road that concrete ties have a great field wherever wooden ties, on account of curvature or for any other reason, fail to maintain gauge, cut out rapidly or are otherwise objectionable.

The chief engineer of the Illinois Central railroad does not regard concrete ties as of much value. Out of twenty different ties made from this material submitted to this road for adoption but three were thought to show sufficient merit to warrant a service test, one of the three being of the reinforced type. Over 50 per cent. of the ties used by this road were found to be cracked and broken, owing to the fact that it is impossible to maintain an even bearing for the lower surface of the tie throughout its entire length, and any unevenness in bearing results in the tie breaking or cracking.

Difficulty was also encountered in finding a satisfactory method of securing the ties to the rails, and no arrangement was made in any of them to keep the rail from creeping. One good point was found in their favor, however, that being their incombustibility, a tie made from concrete being of value at points where the engine fires are drawn or cleaned. Concrete ties withstand the action of the fire indefinitely, where a wooden tie would be destroyed within a few months.

Department of INDUSTRIAL BETTERMENT

EDITED BY

Warwick S. Carpenter.

[This department is devoted to those matters which tend to increase the efficiency, comfort, health and self-respect of employees. It will cover such matters as Industrial Hygiene, Industrial Housing, Industrial Education and others which come under the general head of Welfare Work or Betterment. The readers of The Industrial Magazine are asked to co-operate in making the department a success. Pertinent and valuable suggestions will be published each month. Communications should be addressed to "Department of Industrial Betterment, The Industrial Magazine, Park Row, New York.]

Improving Labor Conditions.

THE Silent Partner is the name of a very valuable little publication issued by the Globe Machine & Stamping Company of Cleveland, Ohio. In the May number appeared a suggestion for the improvement of labor conditions which is somewhat unique and well worthy of careful thought. In the phraseology of The Silent Partner, "The good and wise on both sides of the labor question agree that the improvement of conditions lies in mutual education." The Partner first proceeds to point out certain defects in the present organization of labor which are due to ignorance. Among these are sympathetic strikes, leveling the wages and standing of superior workmen with those inferior, the limitation of apprentices, the boycott of certain products, and the opposition to labor-saving machinery.

The Partner's observations on the sewing-machine are worth quoting. "Haven't you heard people tell about the time the first sewing-machine was introduced into the home town. Old men and women shook their heads and said 'Think of the poor women this hellish thing 'll throw out of work!' Yet today in Cleveland alone there are more men and women employed in running sewing-machines than the entire population of that home town—and the machines are run by power, too. Break up all the sewing machines in the country and you couldn't hire people enough to sew cloth by hand to clothe one-eighth of the population. As soon as sewing machines were introduced people had more clothes and more work done on them. Yes, and it employed men to build the sewing machines."

The key note of The Silent Partner's plan for remedying these conditions is found in publicity. The Partner's idea is for a registered body of employers to print a weekly newspaper that will be handed out with the pay envelopes, or otherwise distributed. It should be a publication which does not pretend anything, but is just what it is, a newspaper not gotten out by a trade journalist, but by a practical daily newspaper man who can size up a class and tell what they want to read. The members of an employers' association should not edit the paper but should turn it over to a competent man who should be allowed to run it until it is learned that he is not bringing the results. The Silent Partner defends this method by the following: "The desire for right must be within the man; that desire must come from knowledge, knowledge will come with education, and education will come from publicity."

The Globe Machine & Stamping Company have offered, voluntarily, to defray the expense of a sample number of such a publication, and the editor of The Silent Partner will edit and have printed one issue of a few hundred copies for circulation among employers and employers' organizations to better illustrate the method and purpose.

The idea is well worth trying and we shall be glad to see what results can be accomplished by it. It seems to us, however, that there is at least one way in which the plan can be improved. American workmen are inherently opposed to any scheme for bettering their condition which savors of paternalism, and paternalism is one of the prominent features in the suggestion of The Silent Partner. The educational propaganda to be disseminated has its inception with the employers. Of course it is planned to have an impartial newspaper man, who can look at conditions from the outside and get the proper prospective, carry on the publication and use his own methods so long as he brings results. Nevertheless he will be the agent of the employers' association alone and it will be necessary from the very start to convince workmen

that he is not partisan. Aside from the natural antagonism which paternalism arouses in the better class of men, the suspicion of partisanship if it obtains a foothold, will be enough to nullify all of the good points of the undertaking.

We suggest that The Silent Partner consider the advisability of giving the men themselves a share in the work. There are plenty of men at the head of labor organizations who are eminently capable of doing their part in such an educational campaign and their number is increasing constantly. It would not be advisable to give over the method of editing the paper which The Silent Partner contemplates—that of entrusting it to a non-partisan newspaper man with the unbiased outside point of view, but it would be well to have him responsible to a joint committee of employers and enlightened leaders of labor.

The Partner says that "the improvement of conditions can come only with mutual education;" but unless both parties have a share in it we do not see how it can be mutual. With this comment we heartily endorse The Silent Partner's suggestion and wish him all success in getting it started.

While paternalism has never worked well in the United States, it seems to have met with very good success in Germany. Workers in almost every industry of the Empire receive compensation for accidents according to their severity, this compensation being paid partly by the government, partly by the employer, and partly by assessments on the workmen themselves. The insurance is compulsory and the administration is under the charge of imperial and state bureaus which are eminently satisfactory in their workings.

In addition to accident insurance, old age pensions have for nearly sixteen years been a feature of the German insurance system and the work in this field is constantly being extended and improved. A bill has just been passed regulating the amount which every workman, employer, and also the state, must contribute toward the pension fund, an amount which varies from one and one-half cents to four cents a week for the workers, the same sum being paid by the employers for each employee, and the state contributing $10.50 annually to each pension when it falls due.

It is well understood in Germany that the contributions which employers are required to make to the pension fund are in no sense a hardship on them, for they are added to the cost of production and immediately passed on to the public. Here they are so widely diffused that their effect is absolutely negligible.

Another phase of the German system is that of hospitals and dispensaries, including dental institutions, for policy holders of the working class. In indorsing the bills which provided for these institutions, the government pointed out that they are in no sense to be considered as a charity, as the much better care which workmen will receive in them will reduce the cost of the insurance department in providing for the men when they are disabled.

Old age pensions and industrial insurance without socialistic features, and without the objectionable points of the life insurance business, is practically what the new savings bank annuity plan of Massachusetts will provide after November 1st. Massachusetts has for several years had experience with an agitation carried on by a small group of persons for the establishment of a system by which the workman will pay taxes during his productive years and come into a pension after he has passed a certain age or become disabled This plan would be compulsory. It is socialistic, however, and has not met with universal support.

In the United States the solution of the industrial insurance problem has often taken the form of Mutual Benefit Societies which, unfortunately, have in many cases not been sufficiently strong financially to weather commercial panics or seasons of great mortality. There have also been co-operative schemes between employers and employees, many of them excellent. There have been some serious objections to them, nevertheless, which still remain unsurmounted.

The new idea, which was given form at the last session of the Massachusetts Legislature, is that of an insurance department to be added to savings banks which comply with certain provisions of this special act. The banks which take advantage of the permission to establish an insurance department will be known as "Savings and Insurance Banks." The two departments, however, will be entirely separate and a loss falling upon one will not be recouped from the profits of the other.

The provisions which must be complied with before a savings bank can open an insurance department are (a) That a special expense

IN THE FIELD

FOR THE ENGINEER AND CONSTRUCTOR

The Cost of Railroad Building.*

BY CHARLES H. COCHRANE.

THERE is so much talk of stock watering these days that the investor in railway securities is often lead to doubt how much of his money is actually spent and invested in the railroad business. It seems that any sort of a railway could be capitalized for a few millions without much regard to its length of trackage, the earnings being the sole thing considered in determining the total of bonds and stocks on which iterest and dividends can be paid.

The matter of railway valuations is important at this time, when there is so much talk of governmental control and of squeezing the water out of stocks. If the Interstate Commerce Commission is to fix rates in the future, and to base them on actual property values, there must be general education in the cost of railway building.

The public has been told recently that several large railways were in the market to borrow hundreds of millions for new construction, and the question naturally rises with the investor whether a railway with a thousand miles of trackage really requires $10,000,000 or $25,000,000 or $50,000,000 to reconstruct them. The best way to form an intelligent idea on this point is to know the average cost of building a mile of railway. With this average in mind the investor in a railway in a mountainous region can roughly double the figures, as he deems the construction difficult, or he can half it in a flat country, and feel that he has some notion of what it costs to build a given railroad.

In investigating this question of the cost per mile of the average American railway, I found no end of difficulty in deciding what were the costs chargeable to such construction. There are something like fifty general divisions of costs in railway building, and some of them may or not be considered as rightly belonging to the mile cost.

I began by eliminating all rolling stock and terminal investments. These certainly have no bearing on the construction per mile. Then came the question of real estate. Its value depends on the place, and its cost to the railway in many cases is nothing. I have eliminated that from my calculations, and finally settled down to figuring the cost of construction, as based upon these general items: Surveys, clearing, grading, roadbed, bridges, trestles, ties, rails, ballast, side tracks and switches, crossings, signals, etc.,—in short, all those items which go to making the railway itself, but omitting all real estate, terminals and equipment.

It is apparent that a price difficulty in calculating the mile cost of railway construction is that the conditions differ with every mile of route. But there are many things common to all lines, and it has been found possible to strike general averages in many instances. Beginning with the actual laying out of a road, including the surveys and drawings of plans and specifications, I find that it is common to survey three routes over a territory and to choose the one that seems the best. In the average country where there are no usual difficulties, this preliminary charge, which we will call engineering, may be set down at $600 a mile. In some cases it may run as low as $250, and in rare instances it might be ten times this amount.

In laying out a route it is the duty of the surveyors to so adjust the gradient that the earth and rock taken from the cuts will fill the low spaces between, so that there will be short hauls of material. In a rolling country, which may be taken as a fair average, there might be two "cuts" in a mile and two "fills" and the average depth of the cuts might be reasonably seven feet, giving an average of 3½ feet depth of cutting for the whole mile. For a single-track road the average width of a 3½ foot cut would be 18 feet. Then multiplying 18 feet by 3½ feet by 1,760 (the number of yards in a mile) we have 12,320 cubic yards of excavation, which we will assume to be

*rom The Van Norden Magazine.

simple signalling apparatus and a $5,000 station every 5 miles.

How does the above tally with the costs as given out by railroads? I have selected nine different sections of railway, choosing those that varied much from each other, and that are fairly representative of some type of construction. Some are in mountainous sections, some near large cities, some follow streams, some run through rolling country, some over flat land, some in mucky soil, some have many bridges and crossings, and some are double and some single track. All were built within the past ten years, and employed rails averaging eighty pounds.

I have found that the average cost of the nine lines selected, when reduced to a single track basis, and exclusive of stations or signalling, was $49,000 a mile, or about double the typical estimate that I have given, which is based on contractors' figures.

Below is a brief description of each of the nine sections of railway:

I. An Eastern New York railroad built 3 2-3 miles of new double-track line in 1903, near a large city. It was necessary to bridge two ravines and the four tracks of the New York Central. The excavation was easy, the material being sand and gravel. Cost per mile $76,000.

II. A Western New York Railroad built eleven miles of new double track in 1898, also near a large city, crossing over four trunk lines of railway and under five trunk lines. In addition there were three streams to cross, the cutting and filling was heavy and the material required a long haul. Cost per mile $50,000.

III. A Southern railway, crossing the Blue Ridge, is now being built, single track, in a very difficult country, involving 35 tunnels in 150 miles. The curves are large and the grades small, adding expense. Cost per mile $125,000.

IV. A Texas single-track railway was built in 1904, twelve miles on mostly level ground, following a ridge that lay between two streams. There was no side-hill cutting and the excavation was mostly earth, though there was some rock. One terminal was in a large city and one railroad had to be crossed overhead, involving a long embankment to raise the grade on bottom land beyond. This condition added over a fifth to the total. Cost per mile, $20,500.

V. A West Virginia railroad built a 10¾ short-cut line in 1903. It was single track and had no sidings. There was considerable rock excavation, mostly in sandstone, limestone and slate. The cuts were numerous and 8 feet wide at the base. The rails were 85 lbs. Cost per mile $78,000.

VI. A Pennsylvania railroad built 9 miles of single track in 1902. There were also 5½ miles of sidings. The line followed mainly the head-waters of a large river, so that there was little cutting. The construction was good, being stone and gravel ballast, with concrete abutments and piers, and 80 lbs rails. The material encountered was earth and loose rock. There were no tunnels and few bridges. Cost per mile, $26,300.

VII. Another Pennsylvania railroad built 15¾ miles of line in a rather hilly, but not mountainous section in 1903. It was single track, with 3½ miles of sidings. There are nine crossings, one of which was costly, and the side-hill cuts are heavy. Cost per mile $37,000.

VIII. A Central Ohio railroad built four miles of single-track line in 1903, with 2½ miles of sidings. The excavation was earth and rock. One ravine was crossed and there was one tunnel. Cost per mile, $41,000.

IX. A railway in Northeast Ohio built 52 miles of double track line in 1903-5, with 25 miles of sidings. The section is thickly populated and 9 miles of the route is through a rolling country, while about 10 miles is hilly. A considerable part of the route lay through mucky soil, where it was hard to secure a solid filling, calling for much ballast. The line was required for speed, so the construction was excellent, with level grades and few curves. Numerous crossings were bridges. Cost per mile, $100,000.

My own estimate of $21,000 a mile is based on interviews with railway contractors. On inquiry, I was told that a contractor could gain speedy wealth by building steam railway lines similar to those on Long Island for $15,000 a mile, exclusive of stations. It is evident that my total of $21,000 would be reduced in such a case by (1) the use of light rails: (2) fewer ties; (3) less cutting and blasting; (4) fewer bridges.

On the other hand, the figures of the railways in several of the instances cited show the high cost in building close to large cities, and in mountainous sections. As there are roughly 225,000 miles of railway in the United States, and only 100 cities with 40,000 or more

A Suggestion in Regard to Reinforced Concrete.

THE various improvements which are taking place from time to time in all branches and departments of the concrete industry, the infusion of new ideas, and the more effective execution of old ones, are bringing both initial and ultimate costs lower and lower each year. Conditions which at present obtain warrant placing the estimate for a concrete structure at a figure nearly identical with that of heavy timber mill construction.

Within the last ten years, improvement in the method of manufacturing and handling of cement, has reduced the price of this essential some 50 per cent. For analogous reasons, namely, recent improvements in crushing machinery, the hardest of stone can be broken and crushed at an expenditure much less than the process of a few years ago necessitated.

It will be noted in this connection that contractors whose work has been such as to make for success, are constantly so systematizing their work as to benefit future construction from past experience. Wooden forms have always proved a large factor in the cost of concrete buildings. In order to reduce the cost of such forms, in so far as may be consistent with proper execution of the work involved, the Frank B. Gilbreth organization has instituted the practice of constructing working models, made on a scale of ⅛" to the inch, showing the latest and best practice, and the most economical jobs that this organization has erected. Such models have been sent to a new job to be inspected, together with a notice that prizes up to $25 be given to the workman offering such suggestions as may cut down the cost and labor on materials; make for greater speed in constructing or in taking down forms; prolong the life of forms, thus increasing the salvage at the completion of the given job; or permit forms to be taken down with the least possible jar to settling concrete.

The last item in particular is of especial importance and has often been neglected by engineers, devoting their efforts in full or in part to work along reinforced concrete lines.

Such a method has also been found to give the benefit to this contractor's organization of the ideas of all the form builders who have been at any time in the employ of other contractors. Incidentally, it affords the further benefit of an intelligent interpretation of local conditions by local carpenters.

The latter factor often completely upsets the most economical ideas in forms designed in another part of the country, because of the impossibility of getting form lumber in the usual standard sizes.

Contractor's Feeding Wagon.*

A contractor near Pasadena, Calif., who uses a large number of teams on work which takes them long distances from home, has built a feeding wagon. This wagon has 9 feed boxes on each side and one at the rear end, thus accommodating 19 horses at one time. The space between the rows of horses is filled with hay. An ordinary wagon gear was used with an extra long reach.

*Courtesy of Popular Mechanics.

Air Pressure in Caisson Work.

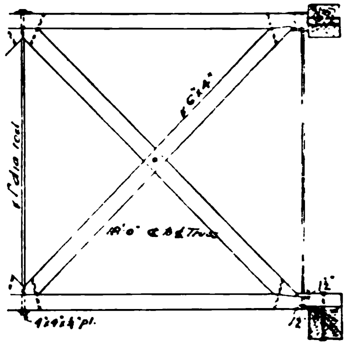
IT has been stated that the caisson work at the bed of the Tauntom River for the foundation of the piers that will support the new bridge at Brightman street, Fall River, Mass., has begun. There are about 75 experienced men at work at compressed air and it will be several days before all of the caissons are down and the full complement of men are at work. Those engaged now are working at the bed of the river under light pressure and are on eight-hour shifts, but it is expected that within a few days heavier pressure will be used and the men will have four-hour shifts. It is not known just how the pressure will have to go but it is probable that at no time will it exceed 15 pounds to the inch. If it goes above that few men can work in it longer than three hours and if it should be necessary to reach 25 pounds in some places hour jobs will be the rule. It has been found that one of the heaviest pressures used was 49 pounds and the limit for any man was 20 minutes. This is said to be the highest pressure ever used and it is also said that no man can live more than a few minutes

Some Good Engineering in Wood Construction.

THE photos and drawings herewith will serve to show the details of some good wooden truss construction on the "Elysium," a large skating rink being built at Cleveland, Ohio. Searles, Hirsch & Gavin were the architects for the building, and the trusses and bases were designed by the Osborn Engineering Company.

There are twelve trusses, each with a span of 100 feet. Each truss weighs 15 tons and contains 5000 feet of lumber. They were built to a form on the ground and raised into position by a rope leading from the top of an A-frame located at the front of the site. $\frac{7}{8}$ inch yellow pine was used in making the trusses. The boards which go to make up the truss are all securely bolted together with $\frac{3}{4}$" bolts. The trusses are 18 feet apart, center to center.

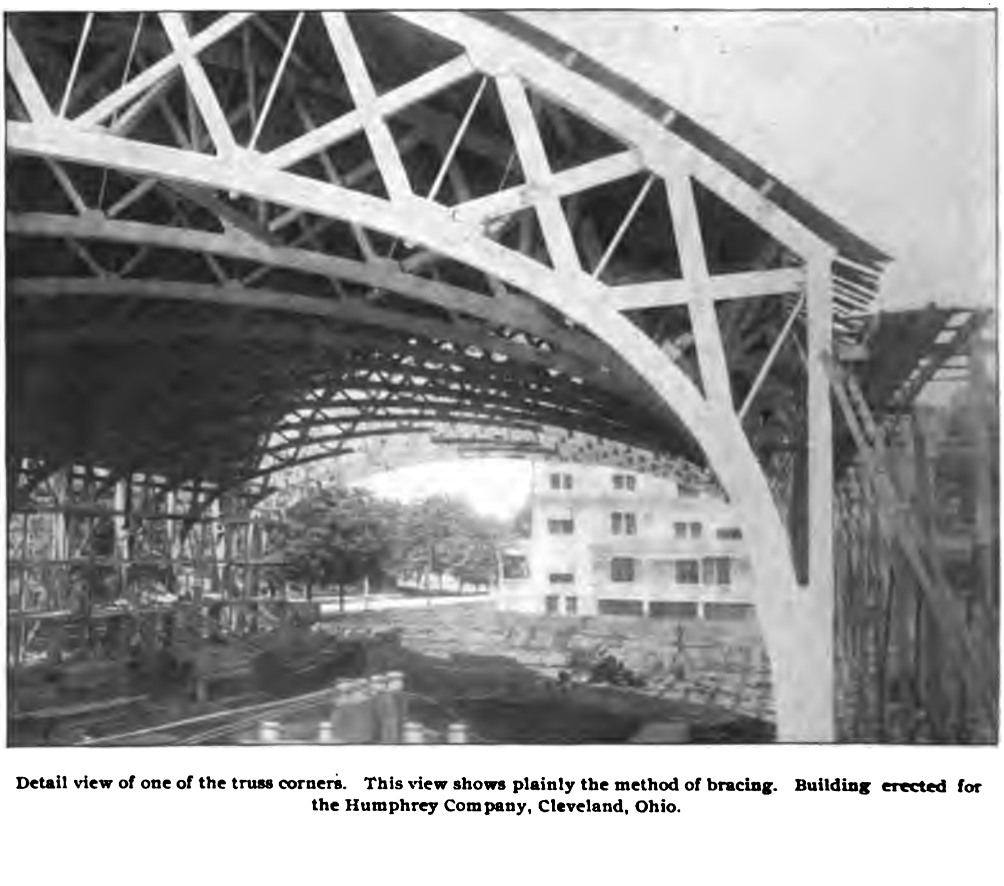
The roof boards were put on diagonally and are $1\frac{3}{4}$" inches thick. All the wooden construction has been extra heavy so as to make the building "slow burning." All the lumber is painted before being put into position.



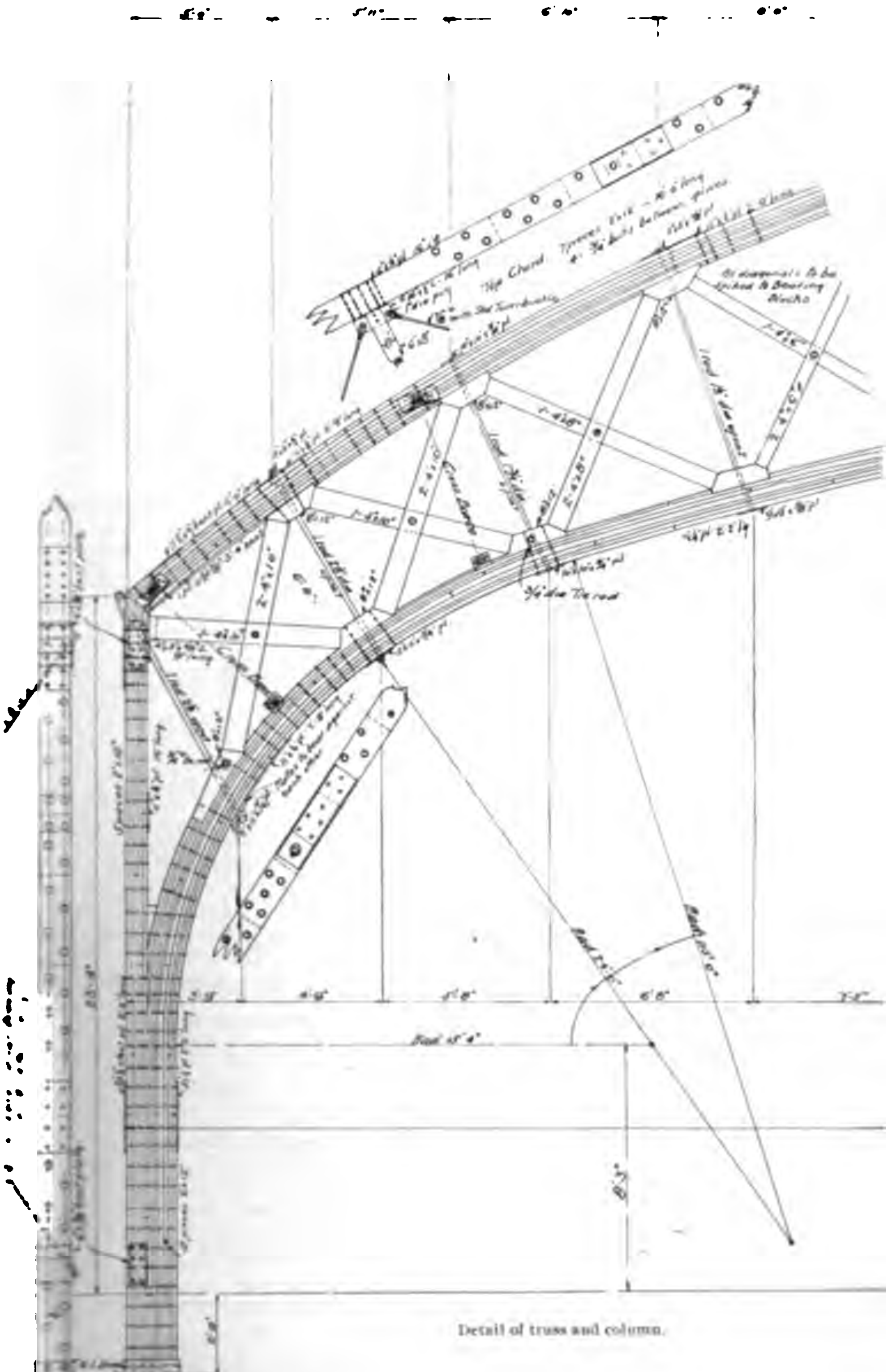
Typical Crossbrace
Cross Braces are in North & South End Panels only

(See page 390 for other half.)

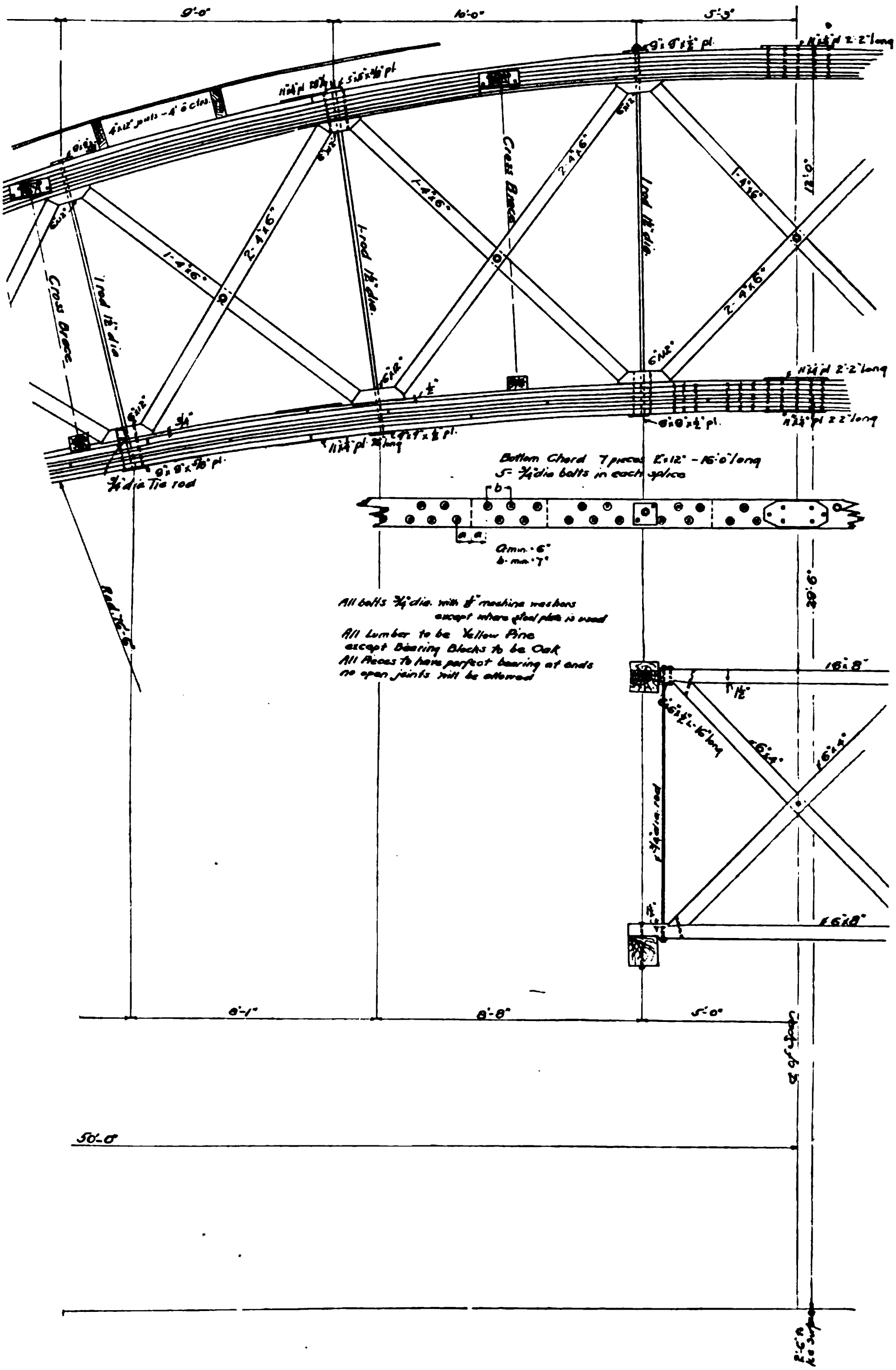
The ice surface will be 30,000 square feet in area. Two 250 H. P. motors and one 120 ton ice machine will comprise the refrigeration plant.



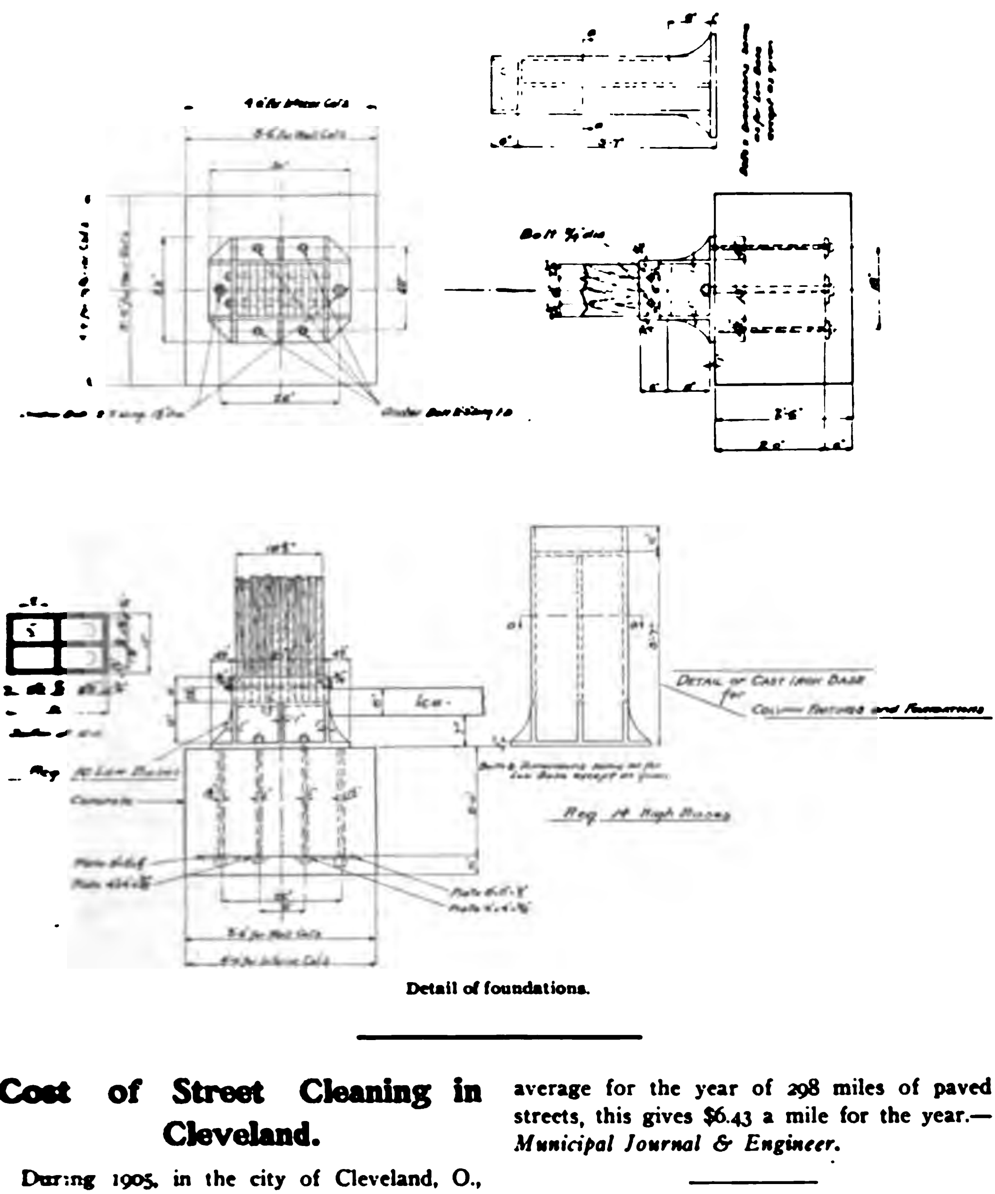
Detail view of one of the truss corners. This view shows plainly the method of bracing. Building erected for the Humphrey Company, Cleveland, Ohio.



Detail of truss and column.



Detail of truss and brace.



Detail of foundations.

Cost of Street Cleaning in Cleveland.

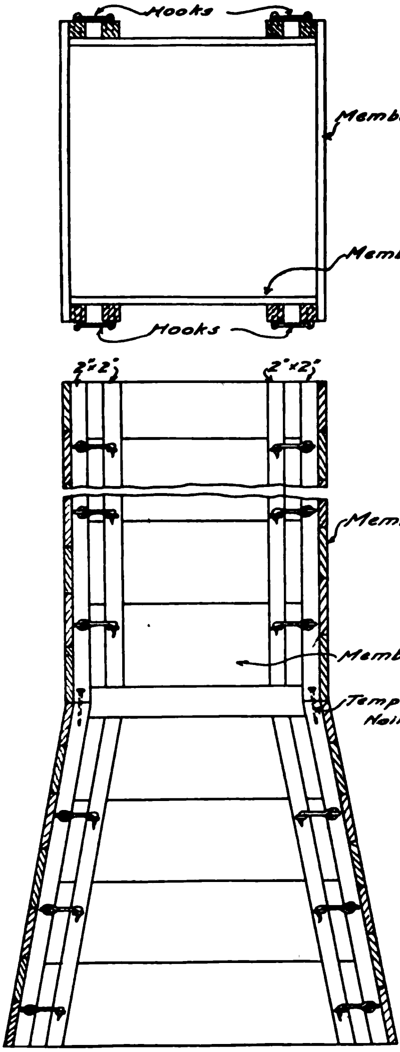
During 1905, in the city of Cleveland, O., [illegible],572 great squares were cleaned by flushing machines at an average cost of 47 cents each; 59,[illegible] great squares were cleaned by machine sweepers and pick-up gangs at an average cost of 99 cents each, and 45,566 loads of street sweepings and 3,405 of snow were removed. The "white wings" (patrol) cleaned 248,188 great squares at an average cost of 22 cents each, or about 22 per cent. of the cost by machine. The relative amounts of dirt removed, however, are not given. Removing snow cost $11,869.53. The total cost of the department was $191,595.94; as there was an average for the year of 298 miles of paved streets, this gives $6.43 a mile for the year.—*Municipal Journal & Engineer.*

Appliances in Concrete Work.

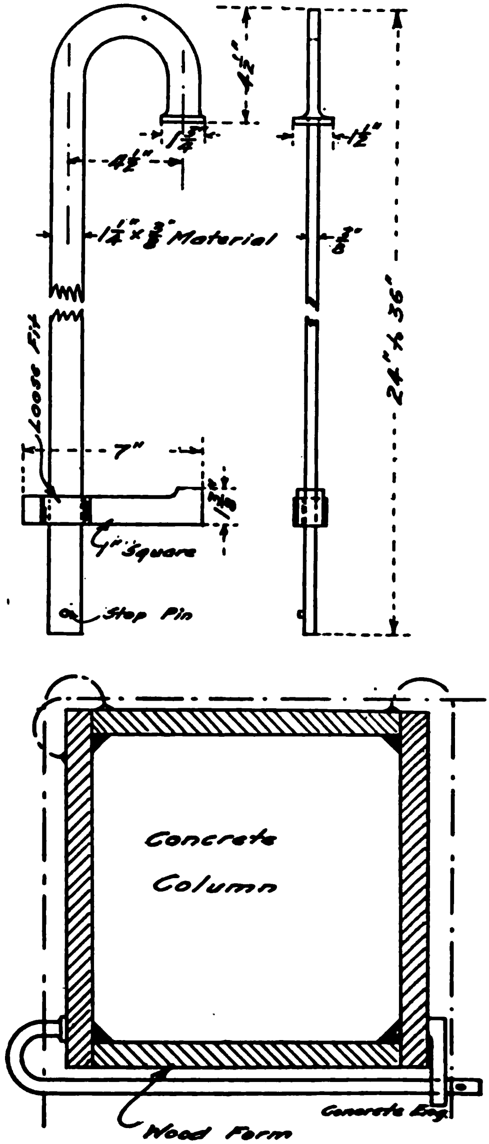
One of the readers of *Concrete Engineering* sends us the sketch shown herewith. It is an adjustable clamp for holding concrete forms together and is forged from 1¼ in. x ⅜ in. steel. It is held in place by the slotted forging 1 in. square by 7 in. long, as shown, by driving it tight. This is not a new idea, however, as it has been in use by the Ferro Concrete Construction Co. of Cincinnati for some time.

Another says:

"In building piers for the conservatory in Garfield park, Chicago, a handy method for tying the four sides of the forms together is in use. Hooks and staples form the ties, and the cleats on member 1, thus further bracing the form against outward pressure on member 2. Member 1 depends upon the hooks for its resistance."



Form for building piers.



DETAILS OF ADJUSTABLE CLAMP FOR HOLDING FORMS TOGETHER.

it will be readily seen that time and labor is saved both in setting up and removing the forms, as well as economy in lumber effected.

"It will be seen that member 2 fits behind

trivial matter and foreign to our purpose, but it is not. Matters of very large importance are often settled by favor, and favor frequently follows social position. Other things being equal, almost anyone will show his friend the preference in business or professional matters. It is even common to stretch a point in favor of a friend.

In business correspondence the value of good usage is still more manifest than in conversation, since the written word is permanent, and correspondence greatly extends the field of one's intercourse. A letter very probably passes through many hands and multiplies the good or bad impressions of the writer it produces. If its import is not clear, it may cause disagreement or involve serious financial disadvantage to the writer. Even bad punctuation will often seriously alter the entire meaning of a sentence, and particularly bad grammar at once stamps a writer as being more or less of an ignoramus. The art of letter writing, like a knowledge of grammar, is commonly considered to be within the range of every one's learning and skill; but anyone who has had large experience in business correspondence knows that few men write good letters. It is so rare to find a matter which is composed of more than one or two items, clearly, concisely and thoroughly discussed in a letter that favorable attention is immediately attracted to its writer. Not a few men owe the opportunity for advancement to their ability to write a good letter. Even though one be thoroughly versed in his subject and his discourse be well worth the time and attention of men of affairs, bad grammar will cast such suspicion over his whole equipment of learning that his argument will often be put aside without substantial consideration. Bad grammar is not a bar to the acquisition of money, but it substantially prohibits the acquisition of high position in the scientific world.

Provoking and expensive errors often arise from the misunderstanding of badly expressed orders, rules, and regulations. In large corporations, especially in railway, contracting, and engineering companies where employes are distributed over a wide area, it is impossible for an officer to give individual instructions, or to see personally that they are carried out; hence, general instructions must be so clear that they cannot be misunderstood or evaded. It is hardly necessary to say that the consequences of a mistake in train orders, in instructions regarding breaking tracks for repairs or renewals, or for making temporary construction to span washouts, may result in expensive and fatal accidents. And even minor errors, oft repeated, may prove very costly.

But the preparation of reports, specifications and contracts is the most particular and momentous task the technical man has to perform. A misused word, or phrase whose meaning is ambiguous, a paragraph that is confused, or the omission of a direction or a precaution, may result in great damage to both the client and the technical man. It is not enough to be careful in a general way. Every word, every phrase, every sentence, has a direct and vital bearing on the work governed by the documents. I have known the presence in a contract of a single word of equivocal meaning to cost one of the parties many thousands of dollars, though when the contract was drawn there was no question regarding the intent of the parties to it. Probably the majority of the civil law suits are caused not by trickery or deceit or dishonesty, but by the use of ambiguous words and phrases, bad ordering of the matter, incompetence and other faults in the language of the correspondence, specifications, and contracts. There is no more certain way for the engineer to protect his own and his client's interests than to prepare all documents in accordance with the best English usage as well as with technical skill; and there is no surer way to lay the foundation for trouble and financial loss than to neglect the character of his language.

Language itself is merely an instrument. The speaker or writer who uses language correctly and fluently but expresses no important thought is a failure; for the sole purpose of good English is to convey the speaker's thought and purpose fully and accurately to his auditors. This service alone will amply repay years of study and a life of care and attention to the use of the English language.

After three years of effort Postmaster Dewstoe has succeeded in getting the postoffice department to accept five 2-cent stamps in lieu of a special delivery stamp. Ordinary stamps with the words "Special Delivery" indorsed on the letter, will now insure prompt delivery, according to an order just issued by the postmaster general.

A Draftsman's Ink Stand.

IN many offices where much tracing or ink work is done, the small Higgins ink bottles, containing about two ounces of ink, are used, and on account of their instability, it is no unusual thing to see one topple over, and if by chance the stopper is not firmly fixed, the harm done is very much against the good temper of the artist or draftsman.

For this reason many contrivances have been resorted to, to give a good base or weight to the bottles, such as washers, weights, blocks of wood, etc., generally carrying with them a very untidy appearance.

Three inkstands, or bottle-holders, are here described, which may be changed or improved to suit each individual taste.

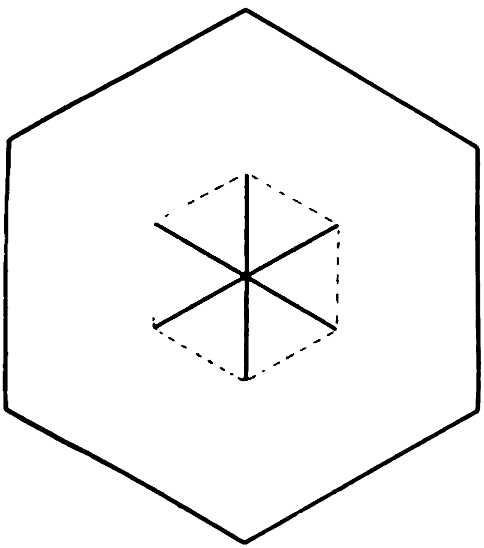


FIG I

Fig. I is perhaps the simplest and easiest made.

A stiff piece of cardboard, such as the back of writing tablets, is cut to a four and a half inch diameter circle, or hexagon.

In the center of the card, another hexagon is constructed, about two inches across the diagonals, which diagonals are cut through the cardboard, and the triangles thus formed, are bent upwards along the dotted lines, as shown in Fig. I.

The ink-bottle is put into place, by placing the card over the stopper of the bottle, and pressing down into position, as shown in Fig. II.

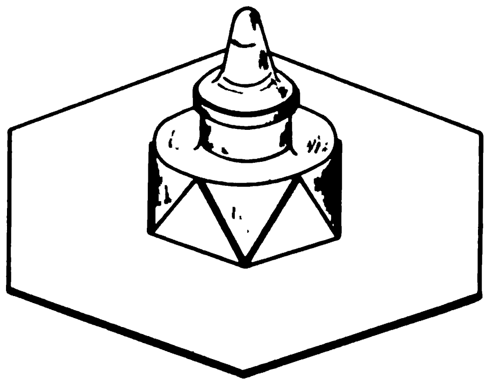


FIG. II.

A double bottle-holder, for red and blue ink, is shown in Fig. III.

It is made of wood, 2½ x 1¾ x 6 inches long, and can be made in one piece, or of two pieces glued together lengthwise, the two holes for the bottle being bored through the three-quarter piece before gluing.

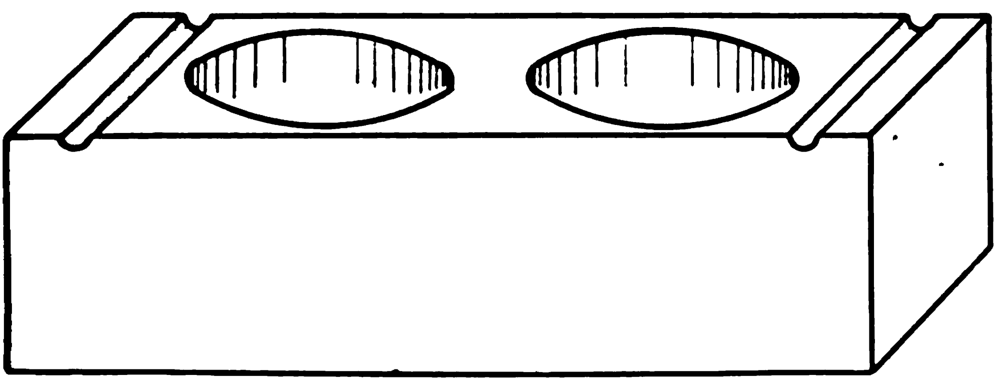


FIG. III.

The holes are one and three-quarters of an inch in diameter, and seven-eighths of an inch deep.

Grooves are made either side for the two pen holders, for red and black ink respectively.

Fig. IV. shows a very convenient ink-stand, with a place for the pens and holders.

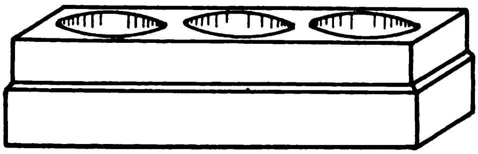


FIG. IV.

A piece of wood, about two and a half inches wide, one inch thick, and eight inches long, for the bottles, is provided with three holes same dimensions as already noted.

This is to be mounted on a hollow box, with a movable front, as shown in section in Fig. V.

The box can be easily made, with no other tools than a good sharp knife, a brass edged ruler or steel straight edge, and a few wire nails or glue.

One piece of wood for the bottom, 3 x ¼ x 8½ inches long. Two pieces for the front and back, 1¼ x ¼ x 8½ inches long. Two pieces for the ends, 1¼ x ¼ x 3 inches long.

The pieces must be champered as shown, and with the exception of the front, must be secured to each other, and the block of wood above, with fine wire nails or glue.

The front is provided with two small brass hinges, and is held closed, by means of an elastic band, fastened to two small tacks or nails, driven into the bottom of the block of wood, and the inside of the front, or door, as shown in Fig. V.

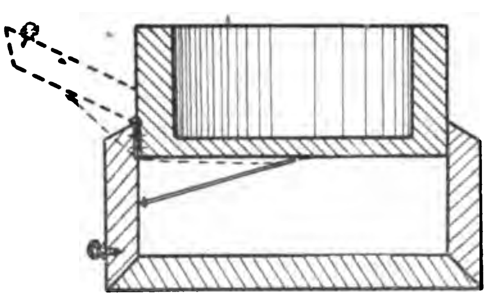


FIG. V.

The pen-holders must be cut down to the proper length if necessary, to fit the box.

A small knob is fastened to the front to open it conveniently. A handle let into the wood flush with the face, may be used instead of the knob, if desired.

A receptacle for the pens and holders, separate from the other instruments, is a good thing, since they are generally besmirched with ink.

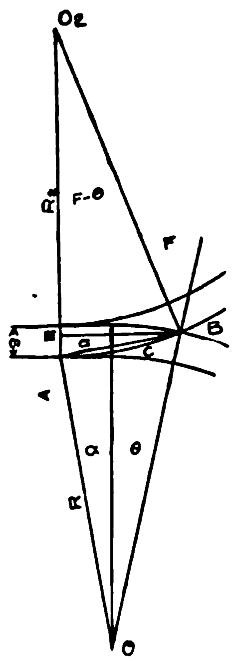
A coat of black varnish will improve the appearance of the ink-stand, and make it more serviceable, since the ink is apt to be spilled when dipping in the pen.

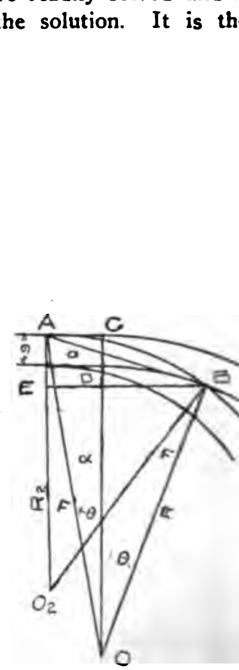
An Interesting Railway Curve Problem.

C. C. WASHINGTON.

Many railroad engineers contend that the best reference book for railway curves is that which contains only the trigonometric tables. They base their argument on the fact that the ordinary field book contains little of real value and that each curve must be solved specifically as the occasion requires.

This is true to a certain extent. Curves of common occurrence are readily solved and it is needless to keep the solution. It is the





[illegible]usual problem that gives trouble and takes time. Its solution may "tie up the party" for several hours and the labor lost by posting the solution in one's field book is certainly repaid in the recurrence of such a problem.

The case given below is one which actually occurred and should be of interest.

Given.—The Radius of main curve, the Frog-number and the distance back of P. C. of main curve to P. C. of Turnout.

Required:—The radius of Turnout curve.

Turnout from convex side of main curve. In triangle O C R

$$\text{Tan } x = \frac{a}{R - \frac{1}{2}g}$$

A O = a cosec x.

In triangle A B O.

$A + B = 180 - (\alpha + \theta)$.

$A\ B = 180° - O_2 A B - \alpha) - (180° - O_2 B A - F) = F - \alpha$.

By Trigonometry:

$$\frac{R - \frac{1}{2}g + a \text{ cosec } x}{R - \frac{1}{2}g - a \text{ cosec } x} = \frac{\text{Tan } \frac{1}{2}[180° - (x + \theta)]}{\text{Tan } \frac{1}{2}(F - x)}$$

whence

$$\cot \tfrac{1}{2}(x + \theta) = \frac{R - \frac{1}{2}g + a \text{ cosec } x}{R - \frac{1}{2}g - a \text{ cosec } x} \text{Tan } \tfrac{1}{2}(F - x)$$

All members of the right hand side of this equation being known, cot $\frac{1}{2}(x+\theta)$ and hence $x + \theta$ may be determined, also θ and $(F - \theta)$. Then in triangle O B D, $B D = (R + \frac{1}{2}g) \sin \theta$. In triangle O_2 B R, $B E = a + B D$ and $R_2 + \frac{1}{2}g = E B \sec (F - \theta)$. Q. E. D.

Turnout from concave side of main curve in triangle O C A

$$\text{Tan } x = \frac{a}{R + \frac{1}{2}g} \qquad A O = a \text{ cosec } x$$

In triangle A B O. $A + B = 180 - x + \theta$ B

$A - O_2 B A + F - (O_2 A B - x) = F + x$.

By Trigonometry

$$\cot \tfrac{1}{2}(x + \theta) = \frac{a \text{ cosec } x + R + \frac{1}{2}g}{a \text{ cosec } x - R - \frac{1}{2}g} \tan \tfrac{1}{2}(F + x).$$

From which θ and $F - \theta$ may be found and R_2 may be easily computed by a method similar to that used in Case I. Q. E. D.—Purdue Engineering Review

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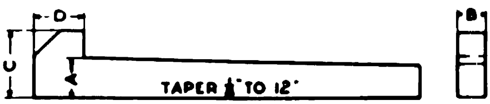
Finished Machine Keys.

Some years ago [illegible] Standard Gauge Steel [illegible] Beaver Falls, Pa., began to manufacture machine finished keys and have perfected quite [illegible] much [illegible] this class of work. Their experience has shown that

1. The width of the keyway or key should be the standard size nearest to one-fourth of the diameter of the shaft.
2. That the thickness of the key may vary from one-sixth to one-fourth diameter of shaft, according to the nature of the work.
3. That the depth in hub for a straight key should be one-third thickness of key.
4. That the depth in hub at the large end of a taper keyway should be three-fifths thickness of key.
5. That standard taper should be one-eighth inch to twelve inches of length.
6. That unless otherwise ordered, the keys are made square at the large end and that all dimensions are taken immediately under the head.



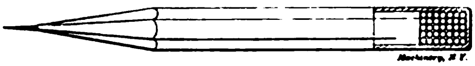
The company lists over 1,600 sizes of square keys with heads and 297 sizes of keys and gibs.

The dimensions of the heads are here shown.

A	B	C	D	A	B	C	D
[illegible]	[illegible]	[illegible]	[illegible]	1[illegible]	1[illegible]	2[illegible]	1[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	1[illegible]	1[illegible]	2[illegible]	1[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	1[illegible]	1[illegible]	3	2
[illegible]	[illegible]	[illegible]	[illegible]	1[illegible]	1[illegible]	3[illegible]	2[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	1[illegible]	1[illegible]	3[illegible]	2[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	1[illegible]	1[illegible]	3[illegible]	2[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	2	2	3[illegible]	2[illegible]
[illegible]	[illegible]	1	[illegible]	2[illegible]	2[illegible]	3[illegible]	2[illegible]
[illegible]	[illegible]	1[illegible]	[illegible]	2[illegible]	2[illegible]	4	2[illegible]
[illegible]	[illegible]	1[illegible]	[illegible]	2[illegible]	2[illegible]	4[illegible]	2[illegible]
[illegible]	[illegible]	1[illegible]	[illegible]	2[illegible]	2[illegible]	4[illegible]	2[illegible]
[illegible]	[illegible]	1[illegible]	[illegible]	2[illegible]	2[illegible]	4[illegible]	2[illegible]
[illegible]	[illegible]	1[illegible]	1	2[illegible]	2[illegible]	4[illegible]	2[illegible]
[illegible]	[illegible]	1[illegible]	1[illegible]	2[illegible]	2[illegible]	4[illegible]	2[illegible]
1	1	1[illegible]	1[illegible]	2[illegible]	2[illegible]	4[illegible]	2[illegible]
1[illegible]	1[illegible]	1[illegible]	1[illegible]	2[illegible]	2[illegible]	4[illegible]	2[illegible]
1[illegible]	1[illegible]	1[illegible]	1[illegible]	2[illegible]	2[illegible]	[illegible]	[illegible]
1[illegible]	1[illegible]	[illegible]	1[illegible]	2[illegible]	[illegible]	[illegible]	[illegible]
1[illegible]	1[illegible]	2	1[illegible]	2[illegible]	2	[illegible]	[illegible]
1[illegible]	1[illegible]	2[illegible]	1[illegible]	2[illegible]	2	[illegible]	[illegible]
1[illegible]	[illegible]	2[illegible]	[illegible]	2[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	2[illegible]	[illegible]	2[illegible]	2	[illegible]	[illegible]
[illegible]	[illegible]	2[illegible]	[illegible]	[illegible]	3	[illegible]	[illegible]
[illegible]	[illegible]	2	[illegible]				

Prevents Lead Pencil Breakage.

A small shell partly filled with a piece of lead, steel or shot, and forced on the end of a drawing pencil, may appear to be a queer con-



trivance; but this end being the heaviest will naturally fall to the floor first, and will prevent the lead from breaking.—Mr. Gordon F. Monahan, in *Machinery*.

Some Day.

There is a big field for endeavor in the problem of how to use the waste of the world.

The Western farmer wastes almost as much land as he cultivates. The price of his acres requires that he must cultivate fewer acres with less waste.

There is a great waste in human effort because "the round man gets in the square hole," and vice versa. A better system of education must find where men belong.

In a thousand ways we spoil almost as much as we make.

What a chance for the inventor's brain!

Some day the mighty forces of the tides, now useless, will be harnessed and the power that is in them set to doing the work of men.

Some day the currents of air that wander idly over the earth's surface, doing no task save that of the turning of a few wind mills, will be tamed into submission and used.

Some day the heat of the sun, so prodigally distributed, will be made to warm the houses of men.

Some day the resident forces of electricity that lie latent will lift many a burden from the shoulders of men and women and little children.

Some day all these great forces will be stored up and ready to be released at the touch of a button.

These powers of nature overflow in wealth. By their surplus energy they give hint of their ability and desire to help us in our tasks. And we will never be content until we get all that is coming to us from them.

And—best of all—the solution of how to use their waste holds the key to better living. —*Milwaukee Journal.*

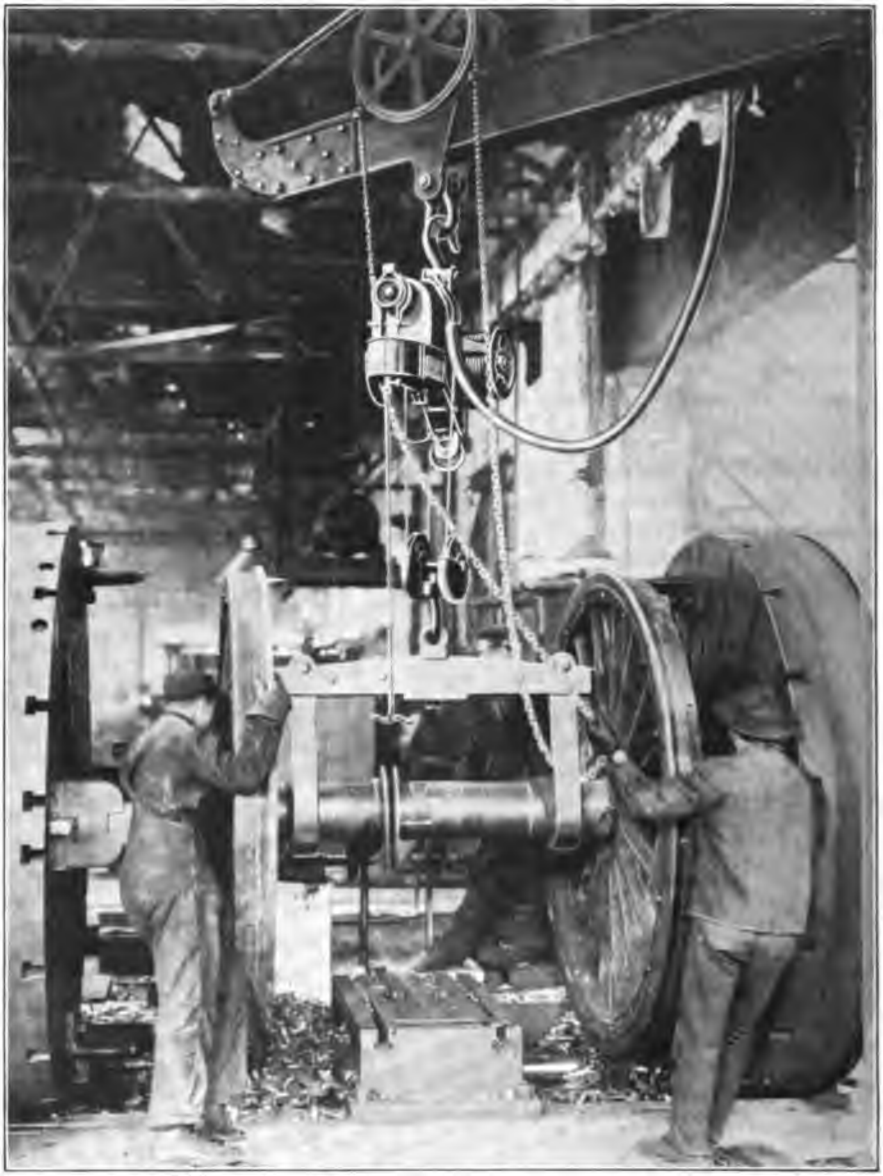
"To criticise another's work, to pick it to pieces, to say where this should have been done instead of that—that is all very easy. But where is the critic who can do the work he is criticising, and do it well? Can he do it at all? In nine cases out of ten, I think not."

to provide the buckets or chain in some way or other with roller supports running on tracks, which of course adds to the intricacy and awkwardness of such conveyors. When designed for heavy work or handling large pieces or parcels they usually are exceedingly clumsy at the best, and their clanking and rattling often reminds one of the boiler shop. At their best also chain bucket conveyors, though possibly more satisfactory on the whole than any other for vertical conveying of coal and other material handled in the same way, are constituted of many wearing parts and therefore require much attention and frequent repairs.

For the continuous elevation of granular and other material handled similarly, some sort of bucket elevators are almost indispensable. The continuous band or belt with metal buckets attached has been for years used in handling grain, and it is doubtful if anything more efficient has ever been devised for handling this kind of material in this way. When made of good material and with buckets of moderate size, these conveyors give almost indefinite service, and that with small attention and repairing. Their usefulness is not limited to grain and the like material, for they are in successful use coveying coal, sand, crushed rock, and even small castings. Such a conveyor moreover has the advantage of relative low first cost and of requiring very little power to operate.

If material is to be conveyed horizontally, or if the lift is not great with respect to the horizontal distance, quite another style of conveyor must be used. Any number of conveyors for horizontal transmission of material have been devised, but very few of them have proved practical and efficient. Screw and worm conveyors, long used for want of something better, are no longer installed for ordinary use. About the only place they can be used to advantage is where speed and power are no consideration and where other forms are not adaptable. An example would be a forced underfeed for a furnace, where the heat of the fire box might damage any other mechanism.. For ordinary conveying, however, scarcely anything could be conceived more inefficient. The amount of power required to move a given quantity of material any given distance is out of all proportion to the work done; and a natural consequence is that there is much wear and the upkeep is high.

The various types of trough conveyors are little better than the screw conveyor. If the trough be suspended and swinging (usually only where a slight fall is possible) the progress of the material is exceedingly slow. If reciprocating flights are employed, the result is little better. A considerable improvement is the use of flights attached to endless chains or cables moving along the axis of the trough and pushing before them

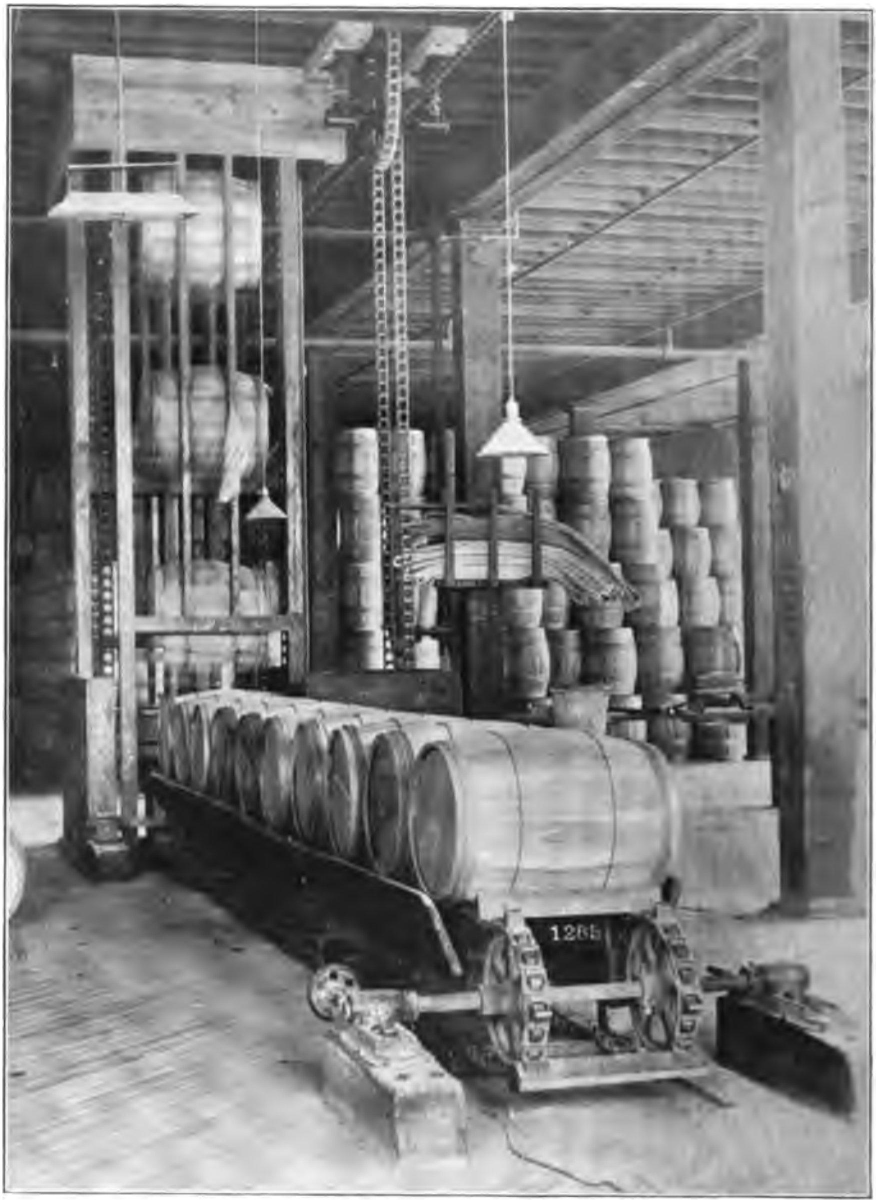


Four-Ton Yale & Towne portable electric hoist on a jib crane serving heavy lathe in West Albany shops of the New York Central R. R.

This is a modification of the table conveyor, and is adaptable to a great variety of work. It is a Link Belt installation.

stiffness or evenness to the carrying surface. Obviously such a contrivance requires much more power to operate than a plain belt does, and having many parts also wears more. But as already indicated, it is frequently necessary to sacrifice low operating cost to expedience or necessity.

A modification of the platform conveyor, in certain cases better adapted to the conditions under which it is to work, is the table conveyor. This also operates continuously (or at intervals if required) and differs from the platform type chiefly in that it consists of a continuous train of continuous tables or platforms. This form has been used successfully



A Link Belt Barrel Conveyor.

A 16-inch "Robins" belt conveyor handling ashes in a large power plant. At the time of taking the picture it was in excellent condition after six years' service.

belt or chain is provided at required intervals with hooks, fingers, or arms. The object to be lifted is placed, in any one of several ways, on a sort of shelf made of projecting arms between which pass the conveyor arms, picking up the object and elevating it to the desired point, where the arms are tripped and the object then slides off into a chute or upon a table, as wanted. For handling barrels, bags, and the like, the arms are generally curved.

Another form of finger conveyor is generally used in a horizontal or inclined position. The parcels or articles ride upon the belt or chain, or in a trough, and are pushed along by the fingers or arms. This is especially useful in handling small parcels, particularly when of uniform

steel cylinder provided with openings or doors at suitable levels. Such an arrangement is compact and free from danger. As in the case of the plain chute the angle can be made to suit the kind of material descending.

Three, and even more, inclines may be contained in such a conveyor, so that it is possible to send material not only from any floor, but also to any other floor, if there be not too many. At the lower end of each incline there should be a friction or other retarder, as in the case of straight chutes. If boxes or other solid freight is to be lowered, the floor of the incline is not infrequently of conical rollers, whose greater diameter is toward the circumference of the helix. The steel chute, however, is nearly always fully as good, and does not require the attention demanded by the roller conveyor.

Hoists for lifting objects from floor to machine, or the reverse, are essential in heavy manufacturing shops. But since they are generally used in connection with trolleys or cranes and have been considered in the previous chapter, it seems unnecessary to speak further of them in this place.

When the tunnel is completed, which, it is now thought, will be about September 1st, 1909, all cars, passenger and freight, will be handled at the terminals by means of high power electric locomotives, operating by a third rail system. This will eliminate the disagreeable features of smoke and consequent bad air in the tunnel and greatly facilitate the switching necessary in the yards. Several sites for the location of the power house operating the terminal zone are under consideration, but as yet the railroad company is unable to determine which will be finally selected.

In making the tunnel plans and specifications it was naturally necessary to consider with great care just what functions the traffic demands would require the tunnel to fulfill. The question of car movement and anticipated volume of business, together with almost endless other problems have entered very largely in connection with physical conditions into the matter of establishing grades at the approaches and the general alignment. The heaviest passenger and freight business handled by the Michigan Central is eastbound, westbound freight cars being largely empties, so that the grade from the center of the river to the portal on the Canadian side is plus one and one-half per cent; on the American side it is plus two per cent.

In many ways the tunnel will be in the nature of an experiment in the handling of traffic. At present the expectations are that it will have an annual capacity of upwards of 1,000,000 cars, and when completed, will be the source of a great saving over the ferry system now in use, increasing facilities from 200 to 300 per cent.

The engineers' diagrams divide the tunnel roughly under the five following heads: Westerly open cut, 1540.07 feet; westerly approach, 2,128.97 feet; sub-aqueous, 2,622 feet; easterly approach, 3,193.14 feet, and easterly open cut, 3,300 feet, making the total distance of excavation 12,786.18 feet, or a trifle more than 2.42 miles from surface to surface.

The tunnel will penetrate blue clay, with small varying quantities of sand, for its entire length. This material was determined by churn drill borings made one on each side of the line every 100 feet of its length between the ends of the approach retaining walls and by four test pits, one close to the water's edge on each side of the river and one further inside on each side. The borings were made with a churn drill working inside a 2½-inch diameter casing while water was being forced through the 1 15-16-inch diameter hollow drill bar. In addition to observing and recording the wash samples, the resistance to penetration of the drill was observed and core samples were taken in many of the holes at points

contiguous to the tunnel bore. According to the resistance to penetration records, the clay at the depth of the tunnel bore is classified as soft. Judging from the test pit records, however, it appeared to be a medium to medium to stiff blue clay, with a varying and at no time large content of sand and gravel. According to the test pit observations also, this clay gave very little wake; a considerable flow came from the sand and gravel strata above the clay bed and from the sand stratum at the bottom of the river.

As certain of the proposed designs called for stagings in the river, the sinking of sections of steel or timber forms, and the depositing of concrete through the wake, careful observations were made of the current velocities. Considerable irregularity was shown by the meter readings, which were taken at four or five depths about every 200 feet across the river; but, generally speaking, the surface velocities were slightly above or below 3 feet per second, and the bottom velocities were from 1.17 feet to 2.29 feet per second.

Excavation has been actively in progress since September, 1906. Most of the work accomplished thus far has been devoted to the three "drifts" each above the other, which have been driven to make way for the "bench wall," or heavy retaining structure of solid concrete, approximately 18 feet in perpendicular thickness, used to reinforce the central or inner arcs of the two tunnel walls.

On either side of the river a blacksmith shop, sawmill and ware houses for the storage of cement have been erected. Two substantial structures are devoted to the use of the engineers as field quarters. In each of these buildings are locker rooms, completely fitted baths, dining room and kitchen, and light, spacious office rooms.

In the yards on the Detroit side four of the eight former tracks have been removed to afford space for the tunnel machinery, for temporary tracks used in carrying off earth brought to the surface, and for room in which the actual excavation is being steadily effected. The double tracks formerly handling the east and west bound passenger trains have been taken up, piles have been driven about 30 feet to clay and on these a surface trestle of heavy timbers has been built. One track takes care of both the incoming and outgoing passenger trains.

The approach tunnels are twin concrete structures between which the retaining wall of the same material is four feet in thickness. This wall contains conduit chambers through which power, telephone and telegraph cables will be strung. The side walls will vary in thickness

from two feet nine inches to four feet, as earth formation and pressure necessitate.

To avoid all possibility of water accumulation, "sumps," or reservoirs, are being constructed at the portals and shafts. These will be equipped with powerful motors and pumps; and the water which may gain entrance by a heavy rainfall will be pumped out as soon as it gathers.

Originally the sides of the bench or retaining wall drifts were stayed by the insertion of heavy upright timbers placed at intervals of two feet from center to center and fastened to cross timbers at the bases and tips, forming a complete wooden framework into which the concrete for the wall was dumped from cars. But the soil encountered was of a blue clay variety, which contains numerous "soft spots" or pockets of sand. The result of this inequality of formation has been that the pressure exerted by the weight of the strata between the roof of the drift and the surface has proven so great that in many places the timbers have settled out of line and buckled so far as to snap in two. The only remedy was more and heavier timbers, and now long stretches of the excavation are lined with wooden braces set almost edge to edge.

The subterranean approach tunnels are being excavated in drifts. The excavation is accomplished by means of a heavy steel shield, eighteen feet in diameter. Thirteen hydraulic jacks, each with a capacity of 60 tons, force this shield forward into the clay. A power plant has been erected on the ground to furnish this hydraulic power and to furnish fresh air to the workings. Bulkheads are put in at distances of about 600 feet. There are hand dug holes of small diameter, spaced about 60 feet apart, for convenience in lowering material. The contract plans specify that the number of shields employed shall be large enough to permit work on at least two faces at once. The shields are to be erected in shield chambers, which shall be an enlargement of the regular section of the tunnel adjacent to the shafts sufficient to permit the contractor to properly erect the shields. The bulkheads or stop-walls closing the spaces between the enlarged sections and the ordinary tunnel sections shall be formed either with special castings or concrete, as the engineer may require. Before starting the shield forward after its erection, a standard cast-iron lining shall be built up temporarily within the enlarged section and within the tail of the shield to perfect shape, alignment and grade to start the permanent lining from and to form a thrust bearing for the shield. After moving the shield out of the enlarged section, all of the cast-iron lining thus temporarily placed shall be removed and the section filled in to normal cross-section.

Bulkheads shall be built in each tunnel at intervals not exceeding 1,000 feet and there shall at no time be an interval of more than 1,000 feet between a shield and the bulkhead nearest to it. They shall be of concrete or of brick set in Portland cement mortar. Each bulkhead shall be provided with two air locks near the bottom at least 6 feet in diameter and 20 feet long for the passage of men and materials, one near the roof as an emergency lock for the passage of men only and a pipe lock 12 inches in diameter and 31 feet long with a gate valve at each end for passing pipes and rails. The emergency lock shall be of ample dimensions to contain the entire force employed at any time at the heading. Stairways and galleries extending the full length of the forward air chamber shall always be maintained to give convenient access thereto and for the purposes of setting out lines and inspection. All parts of bulkheads and air locks must be of sufficient strength to sustain safely a pressure of 45 lbs. per square inch.

With regard to the methods for depositing concrete the plans specify that the contractor may select the tremie properly designed to fit local conditions, drop-bottom buckets or bags. If tremies are used, they shall be constructed of steel, handled by power, so as to be easily adjusted in moving from place to place, and designed so as to give a slow, uniform movement of the mass in passing from the mixing platform to the point of deposit. As a rule, the tremie shall first be filled with concrete, which shall be allowed to escape from the bottom, with the aid of a diver, concrete being placed in at the top as fast as it passes out at the bottom. In this manner the only point where there is danger of washing away of the cement from the aggregate is in the adjusting of the concrete from the bottom of the tremie to its final position. Care shall be taken by the diver that the concrete has no fall thro' the wake, but oozes out so as to cause a minimum disturbance of the material. In passing under and around the tubs it may prove necessary to have curved adjustable lengths provided at the bottom of the tremie for depositing the concrete in places that would be inaccessible for straight tubes.

Where drop-bottom buckets are used, they shall be filled on the mixing platforms and the tops closed, so as to prevent the washing away of the cement in passing through the water. They shall not be dumped until the bucket is close to the point of deposit, so that the concrete will not fall through the water.

Where bags are used, the concrete shall be placed therein on the mixing platforms and lowered to the diver, who shall pack them closely

The final plans, however, included a modification of the first proposal, and it was definitely decided that the object of the work could best be attained by building the steel tubes on shore, excavating the trench in the river and sinking the steel structure to position between rows of temporary piles. The piles are to be so driven that the rows will be approximately 60 feet apart along the tunnels course. For the most part the subaqueous tunnel itself is on what is termed a horizontal tangent with a cross section slightly modified from that of the first plans.

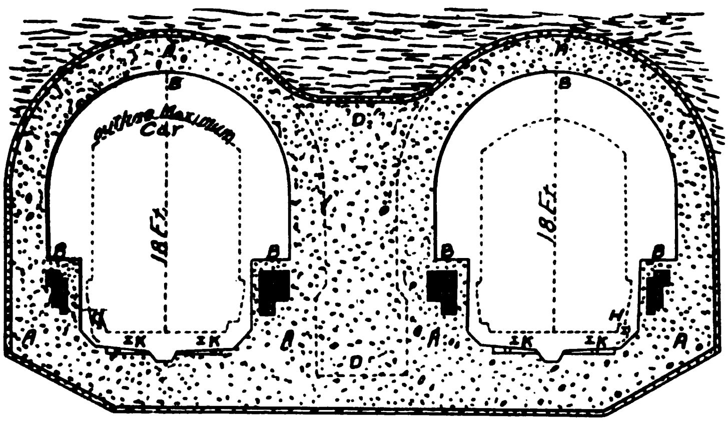
Each of the two tubes is 23 feet 4 inches inside diameter, their centers being 26 feet apart, a mass of concrete is to enclose them which will be over 55 feet in width and nearly 31 feet in depth over all, a lining of special concrete 20 inches thick will be placed inside the tube shells, which are to be made of ⅜-inch steel plates, and this lining will be reenforced by 1-inch steel rods placed horizontally at intervals of approximately 18 inches on centers located about six inches within the interior surface of the thus reinforced lining. To provide for the absorption of the slight moisture which always gradually collects in subaqueous tunnels, a reservoir will be constructed near the center of the river. This sump, as it is called by tunnel builders, will be 4 x 12 feet in size and will be connected with four transverse tunnels 41 feet long

Concrete plant at shaft on American side. To the right at the water edge can be seen the divers' floating outfit.

made of several layers of heavy timber and tightly calked. When this is accomplished, each section of the twin tubes, weighing about 600 tons, will be launched transversely and floated down the river to position between the rows of piles which line the tunnel course. Two steel cylinders 60 feet long and over 10 feet in diameter will be for the time being secured by chains to the diaphragm, and will act as buoyant air chambers, so arranged that they can be easily adjusted in any position along the tubes. The bulkheads are equipped with a series of inlet valves on the bottoms and outlet valves at the tops, these valves being so arranged that they can be operated from above.

As soon as all is in readiness, the lower series are opened admitting water into the tubes. The upper valves are then adjusted to permit the

Cross section Detroit's $10,000,000 Tunnel.



AA concrete. BB $\frac{3}{8}$-inch steel plate. C power, signal and light conduits. D bench or retaining wall. EE River bed. H third rail. KK Traction rail.

discharge of air displaced by the entering water and the outer cylinders placed in the proper position to maintain the tubes on a horizontal plane as they are gradually submerged. The air cylinders are provided with a compressed air mechanism and with such valves that they also may be partially submerged by the addition of water ballast, or elevated by the forcing in of additional air, as the circumstances of the moment may demand. In this way the engineers will have complete control of the entire structure at all times, as the tubes cannot sink except as the buoyancy of the air chambers is overcome by the weight of the water admitted through the bulkhead valves and that allowed to enter through the valves of the air cylinders themselves.

Some difficulty was anticipated in the passing of the sleeves of one tube section over the end of the adjoining section, and so, to eliminate the possibility of the occurrence of any mishap after the tubes are submerged, each section will be provided with sockets of cast steel which will be bolted to the outside of the shell surface. These sockets are so constructed that they may admit pilot pins, six inches in diameter and between five and six feet in length. The plan is to have these pins extend parallel to the axis of the tubes, which will be sunk with the sleeve extending from the rear ends. From the end of the tube already submerged, lines can be made fast to the next section about to be lowered, and by means of lines and power-driven winches on the surface the sinking section can be so guided that the pilot pins may be adjusted in the sockets and the section finally brought into place, the adjoining tube faces having been nicely fitted before either section left the surface. After this is done it will be a comparatively easy matter for the divers to lock the joints and assist those on the surface in depositing the cement grout in the cylindrical joint chambers as soon as all water has been pumped from them. A force pump operated from the surface will deliver the cement which will drive the air contained in the cylinders through a discharge pipe. When the grout begins to appear in this air discharge pipe, the divers will know that the interior cylinder is completely filled.

After an inspection of the joints and the alignment of the sections, water will be admitted to the buoying air cylinders which have been holding the tubes in place, and as the chain fastening them to the diaphragm flanges is relieved of stress by their gradual sinking, the tubes will be allowed to settle gently into final position. The buoys will then be pumped out and allowed to float to the surface ready to lower away the next section, the process being thus continued in the case of each succeeding section until the river is spanned.

Some Interesting Canal Projects.

CUTTING Cape Cod at the shoulder was first advocated by a hardy towns in Massachusetts no one ever hears the State named as the mariner of Sandwich, and while Sandwich is one of the oldest location of the town, it is "Sandwich, Cape Cod." The Cape Codder is unique, he is a type, he loves the wave washed, storm beaten strip of sand which is to him Cape Cod, and that only, first, last and always. When one meets a Cape Cod sailor away on the other side of the world he meets a man from Cape Cod; his native State and country have no place in his proud declaration that he "hails from Cape Cod."

Since 1620 Cape Cod has been a country by itself. It draws a taut line which none will overstep; its people, seafarers, isolated by being surrounded on three sides by water and only hooked fast or moored, as a native would say, to the mainland by a narrow neck of land, the people have become non-gregarious in the extreme and maintain a certain aloofness of manner fostered by the barren land and storm beaten, fog bound life led for many generations. With the seaside vacationist and the Cape Codder the most formal relations have ever been maintained, and it will take some years of the bustle and noise of the commercial era following the canal before the soon to be islanders will be as the other dwellers of the seashore, glad to welcome the summer visitor and the hustling, breezy agent of the busy world. Now that the "right arm of New England" is to be amputated by Surgeon William Barclay Parsons and the expenses of the operation borne by August Belmont and company, the Cape becomes an island and the route from New York to Boston a short, safe and pleasant one.

Sandwich the placid will become a second Liverpool, and the "shore places" of Buzzard's Bay will give way to wharves, docks and warehouses. About fifty thousand vessels of various types now pass or try to pass the cape annually, and with the reduction of time and safety of the passage the canal will afford this number will undoubtedly be greatly added to if not doubled in a short time. The cutting of the Cape Cod Canal has been advocated for more than two hundred years, and many have been the plans proposed. Many men with many ideas have haunted the legislative hall of the State capitol and begged those who engaged in great enterprises for aid in the most feasible and common sense plans

for saving life and property ever proposed on the Atlantic coast of America. After waiting ten years before taking any action whatever on the canal the Council of the Massachusetts Bay Colony finally appointed a committee to look into the matter, and there it began and ended, for the sturdy Puritans were probably too busy hanging witches in Salem or hanging Quakers in Boston to consider canals. If the committee ever reported on the measure no record of the report can be found.

ITS STATE IN 1717.

On some early Dutch maps of the cape country a river or estuary connecting Monument River with the bay, thus forming a channel for small boats, is shown, and in the report of one Captain Cyprian Southack, published in 1717, with a map of a voyage he had just completed, such a waterway is shown, making a voyage in a small boat possible from bay to bay through the shoulder of Cape Cod. This passage is referred to in his report as follows: "The place where I came through with a whale-boat, being ordered by ye governmt to look after ye pirate ship, Whido Bellame, command'r, cast away ye 26th of April, 1717, where I burried

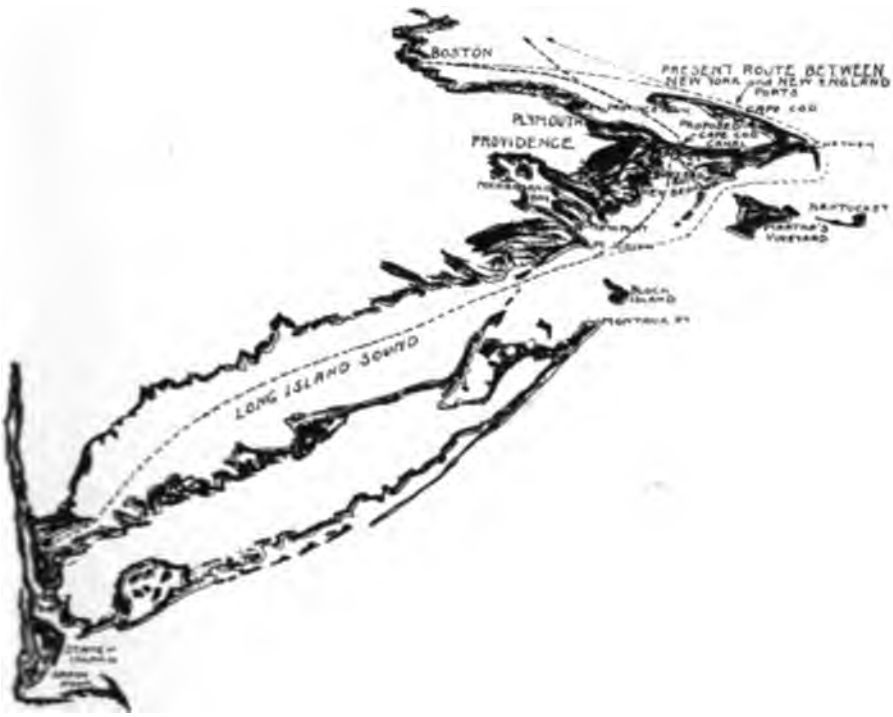


Diagram of old and new routes.

one hundred and two men drowned." That important changes in the physical conformation of the cape have been and are constantly taking place is evident, and it is possible that at the time of Captain Southack's expedition a whaleboat might be navigated from Buzzard's Bay to Sandwich, as indicated in his report.

The island of Nanset, once a cover and breakwater to the harbor of Chatham, is nothing now but a hidden sandbar, where a white smother of foam and a hungry undertow sweep over the bones of long forgotten sailors and the waterlogged timbers of many wrecked vessels. The cape was broader and extended many miles further out into the ocean, but more than two hundred years of storm and strife has wrought many changes, and the maps of yesterday will hardly be found correct tomorrow.

It is recorded that under date of May 1, 1776, the General Court of Massachusetts Bay Colony issued an order authorizing and directing the appointment of a committee of five to proceed to the cape and report on the advisability of cutting the canal, engineers were employed and General Thomas Machin, an engineer and soldier of reputation, undertook the work when a fleet of British vessels anchored in the bay and their hostile attitude with a lack of funds at the disposal of the committee caused the stoppage of the work and the subsequent abandonment of the plans. These plans provided for a channel fourteen feet deep and costing about $175,000. Then came the War of the Revolution and consequent stagnation of all public work. However, Loammi Baldwin made several surveys in 1791, and again in 1818. After thirty years of comparative quiet the Legislature was again petitioned, but not until 1824 was the canal brought prominently to the fore again, when President Monroe advised a resurvey with a recommendation that the government build the canal. The survey was made, reports given and lost in the dim misty dust of political intrigue and finally forgotten until 1860, when the poor old canal came out of its retirement only to run full tilt into the bustle of our civil war, and the impossibility of obtaining money for the enterprise shelved it again and not a spadeful of earth was removed. Shipowners and those most interested in life saving, however, kept the scheme in sight, and after the scars of our internal war began to heal the matter was again brought forward, so that General Foster in 1875 drew up an elaborate plan for a canal without locks. Ten years passed with no action, and then the inventor of a patent dredge went to work and made a very respectable ditch a mile long when he died and his scheme with him.

SCHEME MORE ELABORATE.

Now the design of Foster on a more ambitious scale is to be ex-

River and a ship canal. The proposed Georgian Bay canal is growing nearer and nearer a certainty.

After two years' labor and an expenditure of about half a million dollars the survey work in connection with this route has been completed. This is a plan for the construction of a canal, with a twenty-two foot channel, from the great lakes to Montreal by way of French River, Lake Nipissing and the Ottawa River. It is estimated that its construction would economize the cost of transportation and save from three to five days in wheat and beef shipments from the West to Europe.

It is a huge project, involving an expenditure of not far from $125,000,000. If it is carried out on the proposed lines wheat cargoes can be loaded at Duluth or Fort William and carried without breaking bulk to any part of the world. Ocean going refrigerator ships could load packing house products at Chicago and deliver them at any port where they might be wanted. While shipments by that route would be possible for only a part of the year, the canal and the St. Lawrence would be open while the lakes were open. The plan is not new. It is said that the route was first surveyed by Walter Shanley in 1858, and other surveys have been made at various times since that date. The scheme has many friends in the Dominion government who will urge the taking up of the work at as early a date as possible.

It may not be doubted that the opening of such a route would be a heavy blow to the shipping interests of the United States. New York and Buffalo would be the greatest sufferers. Chicago is working with true Western energy to convert the drainage canal into a ship canal and become a port where all the advantages of deep water freight handling will add to her already great shipping facilities. To become a seaport she must overcome all the obstacles of Mississippi River navigation, and, even with a clear waterway, the route from the Gulf of Mexico is a long and twisted one. Several hundreds of thousands of dollars have already been expended on this idea. It may be a future certainty, but it will be in the dim and distant future, as the lowering of Lake Michigan to a dangerous degree and the deepening and straightening the lower rivers are questions of importance that may not be divorced from the scheme.

Again, Chicago interests are directly affected by the Port Arthur Ship Canal, which gives a part rail connection with the gulf of great importance. Kansas City Southern Railway interests express confidence that Port Arthur, Texas, will soon be made a port of entry. It was on condition that this session of Congress approve a measure to that effect

that the directors of the road empowered Herman Sielcken, chairman of the Board, to make the offer to the government of the ship canal owned by the railway.

By the terms of this offer the government will own the waterways outright, the docks and banks remaining the property of the Port Arthur Canal and Dock Company, which is owned by the railway. Should the government see fit to dredge and widen the canal the railway offers to turn over twenty feet of land for that purpose on either side of the canal.

The ship canal extends from Port Arthur seven miles to deep water on the Gulf of Mexico. It is expected that a great future awaits Port Arthur as a terminal port for oil and grain shipments.

After the Cape Cod canal, the closest second appears to be a canal that will give Pittsburg a shipway between Lake Erie and the Ohio River. This will be of the greatest importance to the iron and steel industry, as it will reduce the cost of conveying the ore from the mines to the mills. The present cost of carrying the ore from Ashtabula to Pittsburg by rail, a distance of about one hundred and fifty miles, is greatly above that of bringing it down from Lake Superior mines, over nine hundred miles, by steamer. With a suitable canal the ore could be taken from the mines to Pittsburg at about what it now costs to ship it to Ashtabula. Pittsburg has great industrial interests in the hands of men who can furnish the capital required, and the Lake Erie to Ohio River Canal is a strong probability.

After the Cape Cod canal comes the scheme of constructing a continuous inside waterway from New York to Florida and thence to the Gulf of Mexico. This is not such a difficult matter as would at first appear, as with rivers, bays and canals it is now possible to cover this entire route with a small vessel.

An Excavator and Conveyor Problem with Five Solutions.

By W. Barnes.

AN interesting problem is found in connection with the open quarrying of brown hematite iron ore in England.

In the quarries dealt with, the iron ore deposits are some 6 to 8 feet in thickness and from 6 to 30 feet below the surface of the ground. These iron ore fields are leased to various companies who are under an agreement with the land owners to pay a royalty of so much per ton for all ore that is taken out, and in addition, to leave the ground in practically the same condition as they found it, excepting, of course, it will be several feet lower. This means that the overburden must first be removed, the ore then taken out and the overburden replaced and left in a leveled state for cultivation purposes. In some fields it is even necessary to replace the soil, originally at the top and some 2 to 3 feet from the surface, back again to the top, as the lower soil is too poor for agricultural purposes. As this has to be done by hand labor it is not considered in the following examples.

A typical section through one of the workings is illustrated on page —, (Fig. 1), the overburden and the iron ore being clearly shown in their respective positions. After the overburden has been stripped off, the ore is loaded either by hand labor or by means of a steam shovel into wagons.

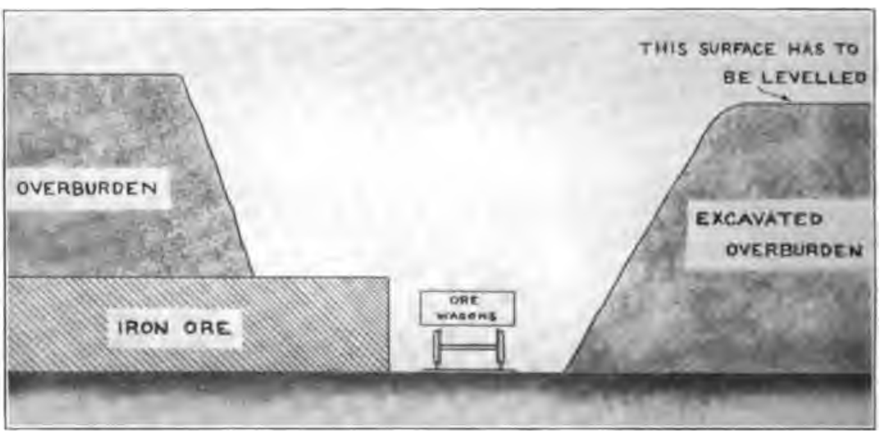


Fig. 1—Sectional view through a typical working.

ore is found among the lower portion of the overburden which has to be sorted out and loaded into the ore wagons.

The illustration on page —, (Fig. 3), shows a huge steam shovel of the crane or revolving type, which has been built to excavate the overburden and discharge it some 70 feet away without the assistance of a conveyor or dump cars. It will swing a complete circle and cut in any position round the machine. It stands upon the top of the iron ore and has a good foundation to work upon, otherwise the great weight of the machine acting through the comparatively small base, would cause the wheels to sink more or less into the ground and so cause trouble. Referring to the illustration the dipper is shown just after the commencement of a cut. When a cut has been taken the upper part of the machine is rotated until the dipper is immediately over the excavated overburden shown in the diagram on Page —, (Fig. 1). The driver then opens the bucket door by means of a latch cord and discharges the material from the dipper. The machine is then rotated or slewed back again and the cycle of operations is repeated. The distance from center of dipper to center of machine is 70 feet. The boom is 70 feet long and the dipper has a capacity of 2 cubic yards. The crowding or thrusting motion on the dipper arm is actuated by a large steam cylinder mounted inside the

Fig. 3—A mammoth steam shovel of the crane or revolving type.

The advantages of the machine are: It requires few men to operate it and the necessity for handling the material twice is avoided, as the machine is in reality an excavator and conveyor combined; also the excavated material can be discharged so as to make the surface of the ground comparatively level.

The disadvantages are: Owing to the great distance of the dipper from the center of the machine the upper structure has to be revolved at a comparatively row rate of speed, so that only one cut per minute can be taken.

Great care has also to be taken to keep the machine level, otherwise it is difficult to rotate in one direction and is liable to swing round of its own accord in the reverse direction.

The weight of the shovel is 70 tons. Moderate material can be excavated at the rate of approximately 800 cubic yards per 10 hours day.

The shovel was made by J. H. Wilsons of Liverpool, the excavator gear being the patent of Simpson & Porter.

In several instances a similar machine to the foregoing is employed but fitted with a grab in place of the dipper and arm. This arrangement is not, however, so effective as the dipper.

Our next solution, page — (Fig. 4), is a steam shovel of the usual size, loading on to an endless conveyor. As in our last example the steam shovel stands on top of the iron ore, whilst the conveyor runs upon a set of temporary rails, laid between the excavated material and the ore wagons, which the men can be seen loading by hand The steam shovel is of the crane or revolving type, weighing 45 tor and carries a 1½ cubic yard dipper. Moderate material is loaded o.. to the conveyor at the rate of 1,200 cubic yards per 10 hours day.

The conveyor, which is about 60 feet long, carries its own engines and boiler and has one engineer in charge. The main framing which carries the traveling wheels on its lower side suports a slewing ring on the upper side, upon which the superstructure can be rotated. The end of the conveyor nearest to the shovel is weighted and rests upon the ironstone. This end also carries a hopper, into which the dipper discharges its contents. The advantages of this arrangement over the preceding example is that owing to the steam shovel being of a normal size a greater output per day can be dealt with and harder material excavated.

Its disadvantages are: (*a*) Two distinct machines are required, together with a double quantity of labor. (*b*) The conveyor takes up valuable room between the iron-ore wagons and the excavated overburden. (*c*) The latter material cannot be leveled, as it is always being discharged at one point, viz., the end of the conveyor, so that it leaves the ground in a series of huge ridges.

The position of the plow upon the rim can be altered by means of a windlass, by the engineer on the machine. The excavated material can therefore be discharged at any point round the circumference of the wheel, as the material is carried round upon the rim (as may be seen in the illustration) until it reaches the plow, and is then shot off at that point. This means the material can be leveled to such an extent that hand labor for this purpose afterward is reduced to a minimum. A revolving hopper between the conveyor wheel and the steam shovel receives the contents of the dipper. From thence it is distributed automatically on to the conveyor rim and carried round until it reaches the plow. The contrivance at first sight looks like what one might call a wild idea, yet the conveyor in actual working is successful from every point of view.

Its advantages are: (*a*) It requires but little power to drive it, due to the way it is pivoted and balanced and the method of driving from the rim. (*b*) It will distribute the material where required by altering the position of the plow. (*c*) Unlike a belt conveyor, there is little or no wear upon it, as this particular one has been at work for nearly 6 months and the paint is not yet worn off the surface of the rim.

The inventor and patentee of this conveyor, Alfred R. Grossmith, has also a new design of excavator in course of construction, to work in conjunction with this conveyor.

This particular excavator was illustrated in the June number of the "Industrial Magazine" this year, page 26, and described on page 28. This excavator when completed will take the place of the steam shovel now used and shown in the illustration. In principle this excavator is of the endless bucket type and discharges the excavated material on to an annular platform revolving round a center tower. From this revolving platform the material is distributed on to the rim of the conveyor, the rest of the operations being as already described. The existing arrangement deals with about 1,000 cubic yards per day, although the conveyor is capable of dealing with double or treble this quantity. It is confidently expected that the output mentioned will be considerably improved upon when the new excavator gets to work.

Our last solution, illustrated on page — (Fig. 6), consists of a combined excavator and conveyor made by the Lubecker Manufacturing Co. The excavator is of the endless bucket type and cuts, unlike the majority of excavators, in a downward direction. As will be noticed, the buckets cut a slope or batter and then take a horizontal direction for 6 feet in order to clean up or level the ground. The frame or boom carrying the chain of buckets is hinged at the end of this horizontal portion and may be lowered out or raised to practically any angle. The lowering out motion is utilized for putting on another cut, so that it is not necessary to

to the housing, the drive being taken on to a similar pulley at the extreme end of the conveyor. The excavated material is taken up in the buckets to the mouth of a shoot situated almost at the top of the machine. The shoot terminates at the end of the conveyor nearest to the machine, so that the material is delivered on to the belt, which runs on troughed rollers, conveyed to the end and discharged in the usual way.

The advantages of this machine are: (*a*) The excavator and the conveyor are contained in the one machine so that only one set of rails is necessary. (*b*) No time is lost through discharging the excavated material, as, when at work, the buckets are continually cutting. (*c*) The labor on the machine is reduced to the minimum, only one engineer being required to look after the whole of the duties, including the firing.

It is practically an ideal machine for the place and the conditions under which it is employed. The material consists of light peaty soil, which it excavates at the rate of 1,200 cubic yards per 10 hours day. The machine will not, however, deal sucessfully with heavy material interspersed with boulders, but is essentially a machine for light materials.

Hydraulic Measuring Instruments.

By R. C. Beardsley.

THE Government of the United States has, for many years, been engaged in measuring the flow of the principal rivers of this country, and it is to the Government we owe practically all the instruments used for such measurements, as well as the methods adopted.

The weir is one of the exceptions, and to trace its originator we would have to go back a number of centuries. It is the most accurate method of measuring water which we have today, and all other devices are referred to the weir as the standard. In view of the fact that the construction of a weir is a comparatively simple and inexpensive affair, it seems strange that it is not used more frequently. It should be used in a large majority of the Government measurements for obtaining the *minimum* flow of streams, and the engineer called upon to measure the flow of a river with a view to its development, should make every effort to get such measurements.

Referring to Figure 1, D is a section showing how the edges of the weir are brought to a sharp level edge. The height of the weir's crest must be sufficient so that whatever the flow may be, the level of the tail water will not rise above the crest. Air must be freely admitted into the space V, as otherwise a vacuum will form and seriously affect the measurements. It is necessary to measure the depth H accurately, and to do this two methods are adopted. For rough work, such as the measurement of stream flow, the Government usually places a long sloping straight-edge A, Fig. 1, on the river bank and fastened to posts driven

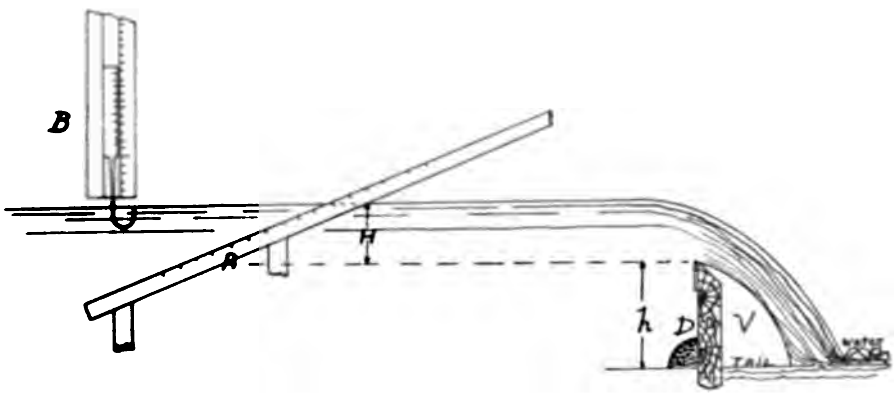


Fig. 1.

into the earth. The edge is so graduated that the divisions are one inch apart, vertically, and the zero mark at the center of the straight-edge on a level with the crest of the weir, or the level of the water selected as datum. With this method, a small rise vertically makes a larger reading along the edge. When a test is to be run on turbines, and extreme accuracy desired, the hook gauge shown at B is used. By means of a level the point of the hook is set level with the crest and the vernier on the staff adjusted so that it is at zero. The hook is then raised until the point makes a minute pimple on the surface of the water and the reading taken. All measurements made to get the depth H, must be made upstream about six feet from the crest, and the hook gauge should be enclosed in a box, which, while open to the full water pressure, protects the hook from all currents.

To build a weir on streams having solid rock bottom, all that is necessary is to drill holes about 18 inches deep and set up the posts A, Figure 3, to hold the weir plank. The edges of the plank in contact with the rock are made water-tight with earth or concrete, as at B. For soft bottoms, provision must be made to prevent undermining, and the writer has found the method illustrated in Figure 4 to be satisfactory.

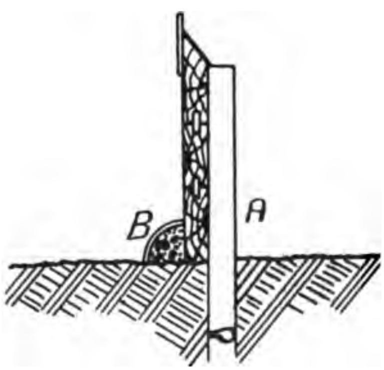


Fig. 2.

The posts A are driven in line and the mat built with holes which fit the location of the posts, and lowered down over them. If there is little current, the mats may be loaded down upon the river bed first and the posts driven through the holes, but usually if the proper place is selected for the measurement, there will be considerable current. Having the mats in place, sheet piling must be driven if the bottom is soft, and the ends thoroughly secured to prevent washing around. Then the weir plank B, E, etc., are put in place. The flow is then calculated from $Q = 3.33 L \sqrt{H^3}$ where L = length of weir in feet, H the depth of water over the crest in feet measured as already described, and Q the cubic feet of water per second.

Next to the weir in order of accuracy is the Venturi Meter. This instrument consists of the mechanism shown in Figure 5. Water enters the meter at A, at such a velocity that at the throat B it will be somewhere between 3 and 6 feet per second. The gauge C will only give proper readings between these velocities, and in order to obtain them, the ratio between the diameter of the tube and the throat must be from 2:9 to 1:16. The tubes on either side of the throat, including the tapers,

may be made of any material, as metal, wood staves or reinforced concrete, but the throat must be of some durable and non-corrodable metal. The head lost by the use of the Venturi is figured as a percentage of the total head H, which is necessary to produce the desired velocity at the throat. Let V_1 = velocity in the tube and V_2 = velocity at the throat. Then $H = \frac{V_2^2 - V_1^2}{64.4}$. The usual loss is about 10 to 15 per cent of H.

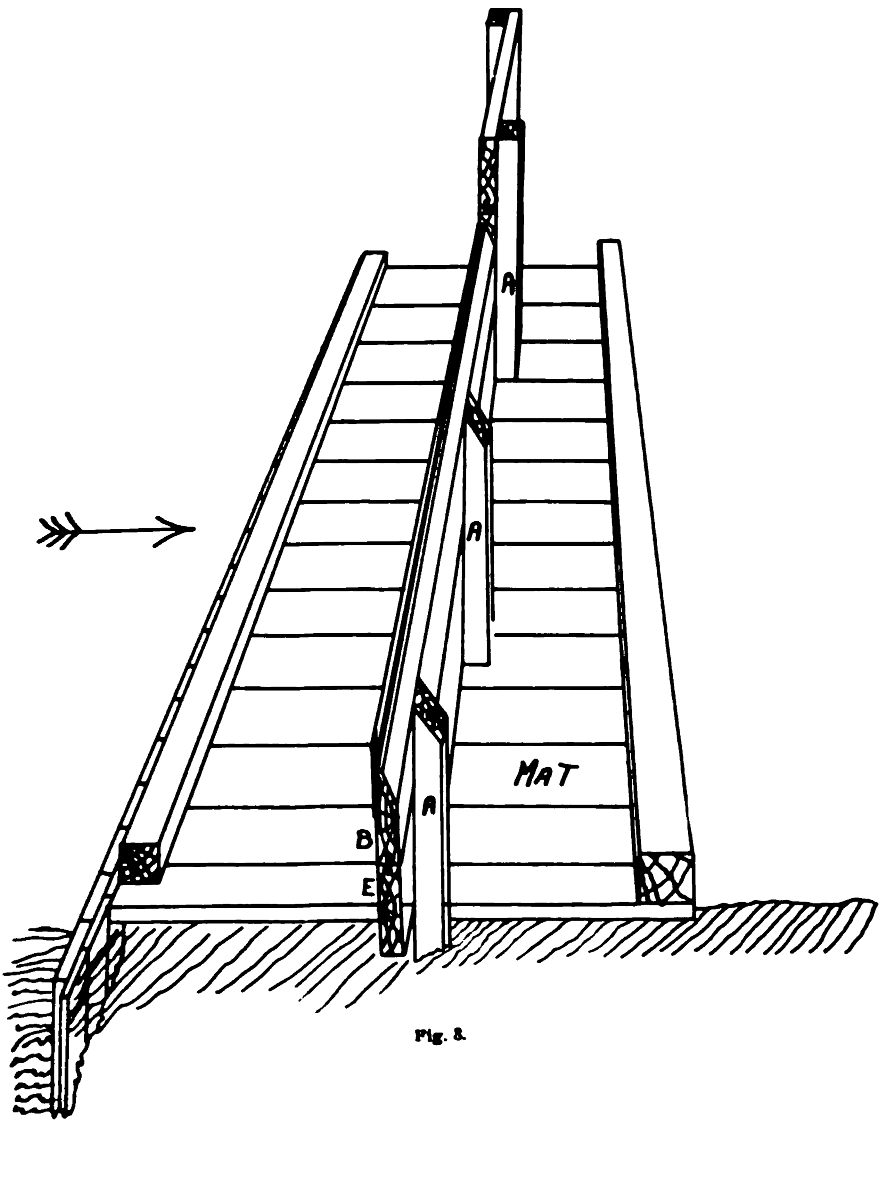


Fig. 8.

The gauge measuring the flow is shown at (C) and its action is caused by the water passing through the throat, producing a partial vacuum which is proportional to the velocity. The reading is then taken the same as those on a barometer.

While Venturi meters are primarily intended for the measurement of the flow in the pipes of city water works, they may frequently be used to measure water power. The accuracy is easily within 3 per cent, and hot or dirty liquids may be measured with equal facility.

Next in order to the fixed measuring devices, are the portable instruments used by the engineer to measure the velocity of the water in streams. Such instruments do not indicate the quantity of water as do the weir or Venturi, but leave the area of the river's cross section to be measured by the engineer and then this area is multiplied by the velocity given by the meter.

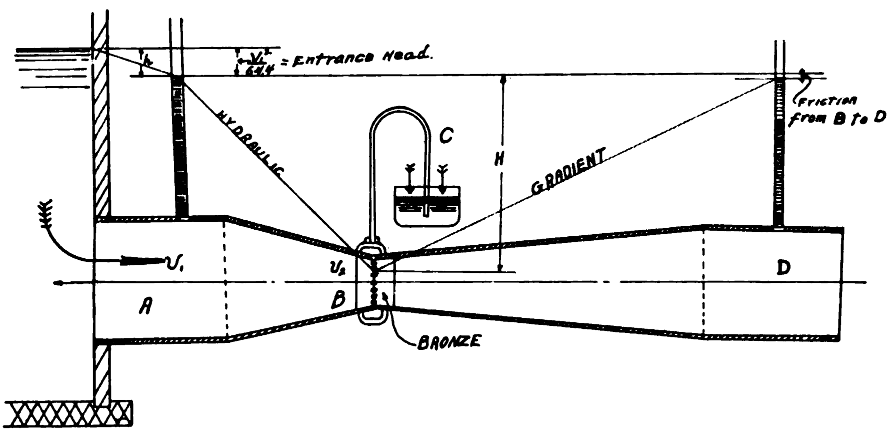


Fig. 4.

There are two types ot current meters on the market, namely, the revolving electric and the direct reading deflecting.

Among the revolving meters the most prominent are the following: "Warren Ball Bearing," "Fteley," "Haskell," "Small Price," "Large Price" and "Colorado." These meters are all of the general type shown in Figure 6 and depend on the revolutions of a wheel for their accuracy. This wheel is mounted on jewel or ball bearings, and is so calibrated that a certain number of revolutions in a certain time indicate a certain velocity. An electrical contact rings a bell every revolution, or, in some cases every ten revolutions. A stop-watch is used to get the time. As the current may be quite strong, a heavy weight of

vane normal to the current as the maximum reading is taken, which must necessarily be the normal position of the vane. As shown, the meter is 24 inches long, and for greater depths 24 inch extensions are added. This meter only weighs about 5 lbs. and is complete in itself. There are no delicate pivots, vanes or rudders to become bent, no wires to entangle or get short circuited, no batteries to run down, and no heavy weights to pay express on or carry.

Another great advantage of the direct reading meter is that it only takes a few seconds to make a reading, and no stop-watches are required. A modification of this meter is made to record on a roll of paper the

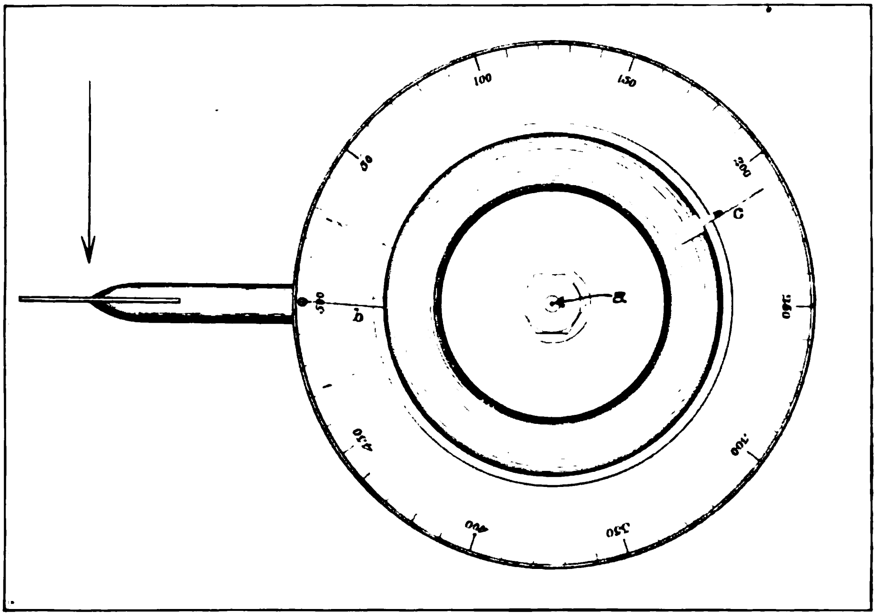


Fig. 7.

velocity and depth, giving the engineer all the information desired except the width of the river.

All meters must be calibrated, and this is usually done by attaching the instrument to a boat which is towed over a marked course at different speeds. The Government has three calibrating stations where the meters are towed by a machine. A curve is then prepared, giving the velocity for each speed of revolution. The direct reading meters are all calibrated in a large revolving tank driven by a motor.

Much depends on the proper selection of the place for making velocity measurements. The best place is where there is a rather strong current and where the sides of the river are as straight and smooth as

possible, and the bottom level and smooth. Measurements made on heavy riffles or in pools are worthless.

There are three methods of taking measurements:

First—Six-tenths single point.

Second—Surface single point.

Third—Integrating.

In the first method, the meter is held at each five or ten foot point across the stream and under water six-tenths the whole depth. The average of these readings is taken as the average velocity of the entire section.

In the second method, the meter is held about twelve inches under water at each measuring point and the average multiplied by .85 to .95, depending on the roughness of the bottom.

In the third method, the meter is slowly lowered to the bottom of the stream at each measuring point, and raised again, and the average gives the average velocity for the section.

Where great accuracy is desired, each of these methods should be used and the average of the three taken.

Meter measurements should give within 10 per cent of weir values. Costs run about as follows:

Weirs—$50.00 up, depending on location.

Venturi Meters with recording gauges:

6 in.—$600.00.

12 in.—$770.00.

24 in.—$1,130.00.

36 in.—$1,680.00.

48 in.—$3,060.00.

60 in.—$4,890.00.

Revolving current meters:

Smallest size, $50.00 to $60.00.

Larger size, $150.00.

To these prices add $8.00 for stop-watch; $50.00 for electric register, and $13.00 for calibration.

Beardsley direct reading deflecting:

Standard with one extension, $50.00.

Recording with one extension, $100.00.

Special recording meters, $150.00 up.

Calibrated and all complete.

The Beardsley Deflecting Meter is manufactured by the Beardsley-Thomas Co., 1123 Schofield Bldg., Cleveland, O.

Misplaced Economy.

The tendency of some people to begrudge every expense for shop equipment is so old and well known a condition that it is needless to repeat it, excepting as a matter of fact. This tendency, however, has had an unfavorable influence on the estimation of the actual value of the milling machine. The successful operation of this machine depends to a great extent, or one might well say chiefly, upon the kind of tools with which it is used. In the successful use of the milling machine on anything excepting the very plainest class of work, the cutters and fixtures used play a role fully as important as that of the machine itself. The firms who begrudge every penny that is spent upon accessories, and simply install a milling machine in the shop provided with plain cutters and arbors, and one or two ordinary vises, and then expect the operator to take any kind of a job and prove the excellence of the machine as compared with a planer or shaper, are greatly mistaken as to the best way of getting the full efficiency out of a milling machine. In such a case one might even say that a great deal of the money paid out for the machine itself is practically wasted. Still, the idea that when a high grade milling machine is installed in the shop, all that is necessary has been done, is a greatly prevalent view, and one which is altogether too common where men, not directly acquainted with the mechanical operations of a shop, and all the little details combined with it, consider themselves able, with little or no advice from the actual operators, to equip the shop in the manner tending to give to each machine its greatest efficiency. In such cases a good machine, which would prove an excellent tool if equipped in the best way, might prove less efficient than older methods. The result is a greatly reduced output and the machine, and sometimes the operator as well, are blamed, when really the cause of the trouble is to be found in the inexperience, and perhaps stinginess, of the very persons who would be most benefited by the additional outlay necessary for proper cutters and fixtures.—*Machinery.*

The Cost of "Progress."

Even if "peace hath her victories no less renowned than war," the price paid for success in the industrial struggle quite equals the cost of the triumph of one army over another in deadly military array. Modern progress comes high when we reckon in the toll of lives, of misery, of sorrow it exacts. Herr Guillery, an official of the Prussian Railway Administration, has prepared a table showing the fatalities caused by the railways of the various countries of the world, and the statistics given therein are nothing less than appalling. Incidentally he finds that the railways of the United States have the unenviable distinction of being the most deadly. Out of every thousand railway employees the ratio of the number injured each year is given as: United States, 43.5; Switzerland, 25.3; England, 11.9; Belgium, 11; Germany, 2.4.

Out of every 10,000 employees the relative figures of killed are: United States, 26.1; England, 12.3; Switzerland, 8.2; Russia, 7.5; British India, 6.7. Belgium, 4.1.

Herr Guillery states that his investigations revealed the fact that in one year—1902-03—76,500 persons were injured by railways in the United States, 60,000 of the number being employees, and 9,800 were killed, of whom 3,600 were employees.

Uses of the Tropics.

The question as to whether the tropics will eventually displace the temperate zones as leaders in civilization has been pretty well threshed out. It has come to be admitted generally that the white man cannot adapt himself to a tropical climate so as do as effective work as he does in colder climates. If he has ever, in his long course of development, been adjusted to tropical conditions, he seems to have lost the power. Additional light has been shed upon the subject by the recent explanation of Major Woodruff, who calls attention to the fact that sunlight is a strong stimulant, reacting powerfully upon human health and life. The white man going to a tropical climate is flooded with sunlight of unaccustomed energy, and over-stimulated. For a while he suffers no ill effects, but rather an exhilaration. Eventually he succumbs to this broadside of unnatural energy. He gets drunk with sunlight, and pays the penalty. The only way the white man has found to resist extinction in the tropics is to change his methods of life, and eat, dress and work as the natives do. He must perforce become lazy and careless. He may drain swamps and kill mosquitoes, but he cannot extinguish the all subduing sunlight.

That is one side of the tropical question. The other affords a vision of vast opportunities. The white man cannot adapt himself to the tropics and work at his old pace, but he can assist in the development of tropical resources to supply the white man's needs at home, where, in temperate regions, he uses up the products of the earth faster than nature can supply them. The solution of the problem seems to lie in balancing the excessive energy of northern races with the excessive natural production of food and other material in the tropics. Near the equator vegetation grows in such luxuriance that the natives, whose wants are simple, cannot use more than a mere fraction of the output. To apply this vast reservoir of vegetable energy to the needs of consumers in the regions where animal life is energetic and vegetable life laggard, seems to be the biggest problem of modern civilization.

The possibilities in the working out of this general principle are just beginning to be appreciated. Increasing transportation facilities have already done much in distributing tropical fruits in temperate zones, but there is one great field almost untouched. That is the supply of tree and plant life available for fuel, paper and other products. The paper problem is one of the gravest now confronting the world. The forests are disappearing and the enormous consumption of paper is constantly increasing Soon there will be few trees available. But in the tropics the supply of fibrous growths suitable for paper making is inexhaustible. It is likely that before many years the tropics will be producing the bulk of the world's paper pulp In this industry, as in many others, the white man can adapt the tropics to his own advantage without any appreciable shift of population

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Credits.

With the daily papers filled with articles about hard times, close money, and high interest rates, it is useless at this time to call attention to other than a few points that are of immediate interest to the average manufacturer.

The condition of the country, as a whole, is far from bad. We have, for the past few years, been reaping bounteous crops and marketing them at good prices. When the agriculturist is in good condition financially, it is pretty safe to conclude the rest of the people are in no distress provided they have been traveling a conservative business path. The present financial ills show the symptoms of speculative folly and the ones who are incurring the greatest losses are the ones for whom the least sympathy is felt. As soon as the wind and water are driven out of the various speculative enterprises and values reach a proper level, the trouble will end.

While this is going on, we must necessarily look for a period of slack business, and the question naturally arises, can we not make good use of the breathing spell. During a period of extreme prosperity, such as we have been experiencing, nearly every shop and factory puts off repairs and general overhauling because of lack of time.

Now is an excellent opportunity to rearrange shop equipment, overhaul stock and make needed improvements to enable one to turn out work with greater facility, less loss of time and consequently more profit.

Slack times can be turned to good advantage and future profit, if we but study the situation carefully.—*Ryerson's Monthly.*

as for instance when starting a pile to avoid dropping the coal so far or in case of accident to the conveyor.

Each bridge is guaranteed to unload vessels at the rate of 150 tons per hour. It is expected however that they will do much better than this under favorable circumstances.

A second 40 ton hopper is also provided on the rear leg. Railroad tracks pass under both front and rear hoppers so that in picking up coal from the dock the bucket will dump into the hopper nearest to the pile in which it is working.

The spouts from the front hoppers are fitted up with screens and by means of an additional spout connecting with an elevator the coal can be passed over a revolving screen located on the roof on the engine room and from there can be placed on the conveyor or spouted directly into cars. The arrangements are such as to allow the making of three sizes of coal and this can be done either as the coal is taken out of the vessel or later on when being loaded into cars.

All engines, boiler and machinery as well as generators for lighting are located in the front tower. The operator's house is situated at one side of the front hopper well to the front which allows an unobstructed view of both vessel and trolley track. The machines are each designed to be operated by one man.

New Unloading Crane.

THE accompanying drawings and photogravures illustrate a novel unloading crane which has recently been installed on one of its scows by the Lake & River Sand Co., of Cleveland. Ohio.

The purpose of this crane is to enable a scow loaded with sand, coal or other similar materials, to discharge its cargo, economically,

New unloading crane of the Lake & River Sand Co.

to a minimum so as not to seriously influence the stability of the scow in rough seas.

The whole structure serves its purpose admirably, unloading sand or coal at the rate of 3 cubic yards per minute, while the low cost of installation ($2,500) for the crane and track assures a profitable return on the investment.

The clam shell bucket used in connection with the crane has proved especially efficient, numerous tests showing it to compare favorably with other buckets of standard make, generally used for such work. It was invented for the purpose by Mr. Callahan, president of the Lake and River Sand Co., who also conceived the idea of the whole plant. The crane was designed and detailed by The Forest City Engineering Co., Cleveland, O., under the personal supervision of Wm. Von Wolfradtt, general manager.

A recent municipal structure in which Raymond concrete piles were used in the foundation work is Public Bath No. 1, at 4th avenue and President street, Brooklyn, N. Y. The architect is Raymond F. Almirall.

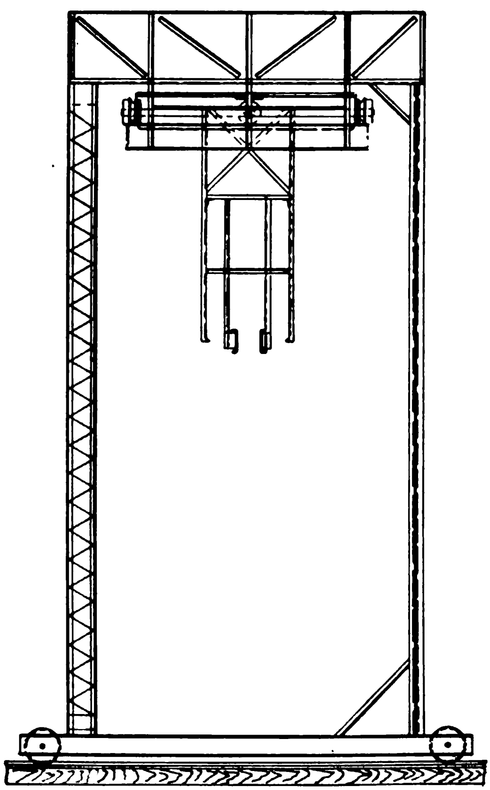


Diagram of front of loading crane.

Coal Pockets Made of Reinforced Concrete.

THE choice of materials for a structure is necessarily dependent on the influences which may cause its rapid deterioration or even destruction. All inflammable railroad structures are especially in danger of catching fire from sparks from locomotives. Coal, when stored in large masses, is sometimes subject to spontaneous combustion. Many railroads have suffered the loss not only of the structure of a coal pocket but also the coal handling machinery and several hundred tons of coal, because they constructed the coal pocket of wood. If the coal pocket was built several years ago, the decision to construct in wood may have been influenced by the then relative cheapness of wood. Even such a justification is fast disappearing. A coal pocket with any considerable capacity has a very heavy unit floor load; the bursting pressure on the sides is very great; the posts which support the whole structure high above the tracks must have great strength. Timber suitable for such purposes must be exceptionally long, large in cross-section and exceptionally perfect. Such timber is getting very scarce and commands a correspondingly high price.

With such disadvantages against construction in wood, one naturally turns to steel, which is non-inflammable (rather than "fireproof"), relatively reasonable in price and easily adaptable to any desired form of structure. But here another objection presents itself. All coal is more or less contaminated with sulphur which combines with water to form sulphuric acid. This rapidly attacks the steel and in a very few years utterly ruins the best steel construction. Any form of paint or protective coating is utterly useless except on the outside, where it is least needed. On the inside of the pocket, the friction of the coal, which is constantly rubbing and wearing against all inner surfaces, will speedily wear off any paint and will leave the metal exposed to the action of the acid.

In the endeavor to retain the steel construction and yet to protect it against corrosion, some coal pockets have been constructed on the general plan of that built by the Link-Belt Company for the Pennsylvania Railroad at Morrisville, Pa., as shown in Fig. 1. The framework of this pocket is made of structural steel, which is designed to carry all the

Fig. 2—Reinforced Concrete Locomotive Coaling and Ash Bin for the Pittsburg & Lake Erie R. R. Co., at Pollock, Pa., employing discharge elevator. Ash bin is served by a gate type bucket, one ton hoist, which is operated on a runway by electric motor. Capacity of coal pocket 200 tons, ash bin 50 tons. Coal elevator 75 tons an hour at speed of 75 feet per minute.

gravity out through the chute (shown in Fig. 3) into the car on the opposite track. The gate, with its lever for working it and the rod and handle, within reach of the ground, are very clearly shown in this figure.

The next two "sections" of the structure contain the coal bin with a capacity of 200 tons of coal. Bituminous coal weighs about 47 pounds per cubic foot; therefore a depth of about 21 feet will develop a pressure of about 1,000 pounds per square foot on the floor—although the pressure near the sides will be less on account of the frictional support which the coal obtains from the side walls. The "floor" is sloping, as is clearly shown in both Fig. 2 and 3. This develops an additional bursting pressure against the side walls around the chutes (shown in Fig. 2). The impact of the coal, falling from the conveyor near the roof to the floor of the bin, perhaps thirty feet below, must also be considered in the calculation.

Coal is brought to the bin in hopper cars which are placed in the position shown in Fig. 3. The hopper gate is partially opened so that the coal falls on to a conveyor belt running 75 feet per minute. This conveyor has a capacity of 75 tons per hour; in other words it will unload a 50-ton car in forty minutes and convey the coal to the top of the bin where it drops on to a cross conveyor belt which carries it over the bin into which it is dumped. The vertical conveyor operates in the last "section" of the structure, just opposite the car, as shown in Fig. 3.

Fig. 3—Another view of Fig. 2.

In Fig. 4 is shown a coke pocket (still incomplete) as built for the Public Service Corporation of New Jersey by R. H. Beaumont & Co. The reinforced concrete details were designed by the writer. Some idea of the magnitude of this structure may be obtained from a statement of dimensions. The height of the peak of the roof from the ground is 54 feet, the height to the top of the concrete is 44 feet; the width of the front is 43 feet while the length (as seen almost on edge in Fig. 4) is 86 feet. The capacity is 1,500 tons of coke. The horizontal beam, shown in Fig. 4, about 9 feet above the bin floor, is designed to carry the bursting pressure of the coke across the entire width of the pocket. The total *depth* (horizontal in this case) of the beam is 24 inches and the *width* (measured vertically) is 12 inches.

Although it may be argued that no coal pockets of reinforced concrete have been built for so many years that there has been any positive demonstration of their ultimate durability, yet the various individual elements of deterioration have ben positively determined. The strength to carry such loads has been very definitely proved. Its non-inflammability is beyond question. The very rigid fire tests which have been repeatedly made by the Building Bureaus of various cities, in which the concrete has been heated to a temperature of 1,800 degrees or even 2,000 degrees F. and then subjected to a stream of water have shown its qualities in this respect, especially

Fig 4—Reinforced Concrete Coal Pocket at Camden, N. J. Capacity 1500 tons. Built for Public Service Corporation by R. H. Beaumont & Co., concrete details designed by Webb, C. E.

when we consider that even the combustion of the coal in the pocket could hardly heat up the concrete under it or beside it to the temperature attained by the concrete roof in one of the regulation fire tests. The recent ignition by spontaneous combustion of the coal in the bunkers of the battleship Indiana, which nearly resulted in the total destruction of the vessel by explosion of its magazines, is merely a fresh illustration of the dangers of spontaneous combustion. Neither a wooden nor an all-steel coal pocket could endure such a fire. Under such conditions a reinforced concrete coal pocket would not be destroyed and could be repaired with comparatively small expense. It is probable that such coal pockets will in a few years become the standard for all first class roads.

Public Improvements at Gary, Ind.

THE plans for the city of Gary, Ind., to house the employes of the great steel plant of the United States Steel Corporation, which is under construction on the shore of Lake Michigan, are progressing rapidly, and much has been done in the year since it was begun.

The main sewers for the portion of the town under construction have most of them been completed and work is progressing on the lateral sewers.

The general level of the town is some 20 to 25 feet above the lake level, and the streets are laid out to preserve this general level. There are numerous dunes and depressions in the sand with which the site is covered, requiring considerable shifting of material to reduce everything to the dead level. It is evidently necessary under such a plan to carry off the storm water through sewers in every block. The sewers are laid, with water and gas pipes and conduits, in the alleys, which are made 20 and 30 feet wide, that there may be plenty of room for them all. The street gutters are given a fall from each street corner to catch basins at the alley intersections, two basins being thus located at the middle of the block. A street running parallel to a sewer is served by two basins at the middle of each block, the basins draining through a lateral a half-block long down the alley which crosses at that point. This does not reduce the number of catch basins necessary to drain the streets surrounding a block, but gives an opportunity for a better treatment of the curbs at the street intersections. It does not do away with the step-off from curb to pavement at the street crossings, but makes a more shallow gutter at this point possible. This seems to be done, not by giving the curb a flatter grade than the gutter, but by making the curb in the form of steps at the street intersections. House connections to the sewers are made through the rear of the lots.

Concrete curbs and gutters are used throughout. Broadway and Fifth Avenue, the principal business streets, are paved with concrete. The base is 5 inches thick and made of concrete in the proportions of 1 part Universal Portland cement, 2 parts coarse sand and 4 parts of crushed limestone ¼ to 1 inch in diameter. The top is 2 inches thick and is composed of 5 parts Universal Portland cement and 7 parts of granite screenings. The surface is laid out in grooves ½ inch wide and ½ inch deep, giving an appearance of blocks 4½ by 9 inches in horizontal dimensions. One-inch expansion joints filled with an asphalt filler are put in across the street every 75 feet, and along each gutter. The curbs have joints every 6 feet and a joint through both curb and gutter is put in every 24 feet. If the cement sidewalk comes up to the curb a 1-inch joint is left between walk and curb. At present, there is a 20 foot strip left in the center of the street in which the street railway will be laid. Undoubtedly the provisions for expansion described are sufficient until this space is filled. The total width of each of the two paved streets between curbs is 66 feet and the sidewalk spaces on each side are 17 feet wide.

Residence streets are 60 feet wide, are paved with macadam 28 feet wide and a 4-foot sidewalk on each side set in a wide lawn. This leaves 12 feet of lawn, and the widening of cement walks, which will be found necessary on the more thickly settled streets and those toward the center of town, can be made without disfigurement.

The base of the macadam pavements is made of slag 10 inches thick at the crown and 6 inches at the curbs, and this is covered with crushed granite passing a 1-inch screen, held together by a mixture of dirty gravel having some cementing qualities. This layer is 3 inches thick at the crown and 2 inches at the curb. A ½-inch layer of fine granite screenings is rolled into the surface.

is the modern and up-to-date Parker derrick. Since the introduction of this machine in 1901 it has been improved and perfected. The derrick is now a model of simplicity, consisting of very few parts, namely:

The manufacturers have a very neat catalogue describing their line in full, together with numerous photographs and testimonials of their products, which will be sent upon application. The manufacturers have an efficient staff of engineers and are in shape to design or manufacture anything in the hoisting line and will be pleased to communicate wtih any one who may have work of the character in contemplation.

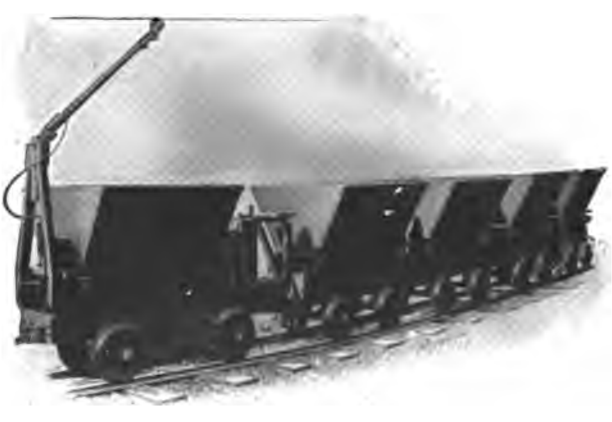
Electric Dump Cars.

THE illustration herewith shows a novel electrically driven dump car brought out by the Jeffrey Manufacturing Co., of Columbus, Ohio, the well-known manufacturers of electric locomotives and motor car equipments.

This dump car is standard in design, with a steel frame, constructed so that an electric motor can be attached for operating it. A simple form of under-running trolley, together with controlling devices for operating the car, are used, as will be seen in the illustration.

The dump car here shown has a capacity for handling 32 cubic feet of earth or similar material, but other sizes are manufactured to suit various requirements. An electric motor of proper capacity to suit the size of the car is geared to one axle by single reduction gearing. The total weight of the empty car with electrical equipment is approximately 2,900 pounds. It is capable of hauling a train of several other cars as trailers. It makes a very simple equipment and one which will appeal to contractors who have access to electric power.

This type of electrically propelled dump car is said to be very easily handled and at a minimum of expense. Full data regarding equipments of this kind can be hrd by addressing the manufacturers.



Will Make Concrete Poles.

THE American Concrete Pole Company has just been organized at Richmond, Ind., with a capitalization of $10,000. William M. Bailey is the inventor of the process by means of which the company will manufacture the poles.

The poles are constructed along the general lines of reinforced concrete work, but the process possesses a number of distinctive features. A series of twisted electro-carbon steel rods is used, held in position and bound together by spiral reinforcement. Concrete is placed about this foundation, being poured in patented adjustable molds. Poles over 35 feet in length will be cast in the holes, using the molds just mentioned.

Tests made on poles manufactured by this process are said to have shown gratifying results. One, 30 foot long, which was cast in a horizontal position a year ago, was hauled nine blocks and set up in the rear of the telephone building at Richmond. It is stated that it shows absolutely no sign of deterioration. The company is at present engaged in erecting a line of 45 foot, 50 foot, and 55 foot poles across the White Water river bottom at Richmond, to carry the cables of the Home Telephone Company.

Contrary to the general impression, it appears that these poles develop considerable elasticity and recovery from stress. One 30 foot pole was subjected to a strain of 3,100 pounds at the top and deflected 30 inches from the perpendicular before the cement cracked. A sound cedar pole of like dimensions broke under a stress of 2,200 pounds, showing that the concrete pole has the capacity to resist strain about one-third greater than that possessed by wood. Even the crack-

Pacific Coast Letter.

BY J. M. BALTIMORE.

Another immense industry has been formally inaugurated in California which will involve a very large sum of money—for the erection of the necessary building, installing of the great plant, and the maintenance of the work. The project is to construct and maintain a huge beet-sugar factory, and a number of the leading capitalists of Southern California are interested in the new enterprise.

Very recently, the corner stone of the main building was formally laid in the presence of a great crowd with appropriate exercises—speeches, music and banquet. This new and important industry will be located at the town of Corcoran in the San Joaquin Valley. To construct the necessary buildings, purchase and duly install the immense sugar-producing and sugar-refining plant, will, it is estimated, cost at least $1,000,000, alone, to say nothing of the cost of operating the industry.

Behind this important enterprise is the Security Land and Loan Company of Los Angeles, and the Pacific Sugar Corporation. The soil and climate of the San Joaquin Valley is admirably adapted to the growth of the sugar beet, and the projected sugar refinery will consume all the crops that may be cultivated on many thousands of acres The raising of the sugar beet will henceforth be carried on in that region on an immense scale.

For several years a sugar refining factory has been in very successful operation in the Visalia district. The capacity of the Visalia plant is about 800 sacks daily. This sells at the factory for more than $4,000. The factory consumes about 400 tons of the raw beets daily; but the capacity of the new factory at Corcoran will have a daily capacity of 700 tons of the raw material.

In the Corcoran district, this year, the average yield of beets was 14 tons to the acre. However, some fields harvested as high as 28 tons to the acre, but these were the exceptions. The beets are contracted for at $5 a ton. The cost of production to the farmer is about $2.50 a ton.

In the Visalia district 6,000 acres will be devoted to beets at the next planting; Corcoran will seed over 5,000 acres, and another 2,000 acres will be seeded in the territory tributary to Corcoran.

The order for the machinery and refining plant for the Corcoran factory was ordered in the East some time ago. Work on the new and immense factory building is now being rushed with all possible vigor. The new building will be mainly of reinforced concrete with structural steel frame. It will be made practically fire proof and of Class A.

All the redwood railroad ties on the Harriman lines in the southwest are to be replaced with pine as rapidly as possible. This has become necessary, because the redwood ties are fast yielding to the dry rot, and the wood is becoming too expensive.

Pine ties are arriving in vast numbers by vessel from the north at San Pedro. Already about thirty acres at Los Angeles belonging to the Southern Pacific, are stacked with

An immense sugar factory.

leads up to the famous Feather River Canyon, along which a great many difficult engineering difficulties have to be overcome. The accompanying photograph shows one (of a great many) of the giant shovels at work on a big side cut in the Feather river division of the Western Pacific's line. This shovel (a Marion shovel, model 60) is making the earth and rock fly at a lively rate, as may be seen.

Very recently the Southern Pacific company has installed in its immense freight yards in Oakland, Cal., a very large railway tie-treating plant. This plant is the largest on the entire Pacific coast, and one of the first used by that system. The plant is known as the "Burnettizing Plant," or works. Many thousands of ties are now being treated with a preparation which insures their preservation for years. This immense plant is portable, although the boilers weigh in the neighborhood of 600 tons.

The ties or timbers, be they large or small, are loaded on a steel-frame truck, and are run into the boilers which are about 300 feet long. A mixture of crude oil, creosote, and other wood preservatives is pumped into the boiler and mixed with steam. For 12 hours or longer the ties and timbers remain in the boiler until they have been very thoroughly penetrated by the mixture. Timber thus treated will last nearly twice as long than if not saturated with the preservative mixture.

"Combustible America."

Our annual fire bill has been steadily growing as our population increases and the housing facilities try to keep pace with the expansion. Not even the spectacular burning of Rome, nor the great conflagration of ancient London, compares in extent with the vast destruction of property by fire in the United States in a single year. The record for 1906 stands unusually high owing to the burning of San Francisco. The total losses for that year in the United States and Canada by fire was $537,860,400. Of this vast sum San Francisco was responsible for some $350,000,000, including buildings and contents.

Compare this enormous destruction of property with the investments in new building enterprises. In 1905, building operations throughout the country represented a total investment of $525,000,000, and that of 1906—the high-water mark in the nation's history—approximated $700,000,000. Thus during the greatest building year of history, noted for its phenomenal prosperity in nearly every industry, we have been able to replace only a little more than what we burnt down. In 1904 our fire losses aggregated $229,198,050, and this was greater than those of the previous year, not even excepting the years 1872 and 1873 when the great Chicago and Boston fires added enormously to the total. In 1905 the losses from fire showed a still further increase, culminating in the great record of 1906.

But the waste through fire consumption is not the only loss which the people must pay for any extended conflagration. While the fire losses of San Francisco have been placed at $350,000,000, it is estimated that the loss to business in that city and throughout the country will aggregate at least $1,000,000,000. It cost about $12,000,000 to clean up the debris and put the city in shape for new buildings and a further $350,000,000 to rebuild and make the city what it was before. It will take ten years to give the city its former prestige and at least twenty years to recover all of its lost trade and position. In return for this loss in property and business the citizens of San Francisco received something like $135,000,000 insurance. The amount of insurance covering property in the burned district was approximately $235,000,000. Final payments by the companies will probably be in the neighborhood of eighty per cent of the amount of insurance involved. In the great Chicago fire only fifty per cent of the insurance was paid, and in the Baltimore fire—where no earthquake occurred to invalidate any of the insurance—the payments were ninety per cent of the value of insurance. The known ratio of insurance to value was about seventy per cent, and at least five per cent of the property carried no insurance whatever.—George Ethelbert Walsh in Harper's Weekly.

October 1 at Friedrichshofen, Germany, Count Zepplin made a successful flight in his air ship. Covered about 220 miles in the several hours he was aloft.—*Boston Transcript, Oct. 1, '07.*

Ambrose Channel, the new deep waterway leading from Sandy Hook over the shoals of the lower bay to New York Harbor, was tested Aug. 27th, for the first time by one of the big transatlantic steamers, when the Cunard liner Caronia safely passed through it on her voyage to Liverpool.

the poor devil who buys them is led to believe that this remarkable deformity will bond together properly the sand and stone in the concrete, and hence there is little (if any) need of cement and proper design or workmanship, as no adhesion is required; with the natural result that 90 per cent of the failures occur with this class of reinforcement."

Mr. Turner also gives the following interesting comparison between the carrying power of deformed and plain bars as applied to a warehouse building in Milwaukee where plain bars were used, in which a panel was tested with a load of 284,000 pounds, giving a total load of 312,000 pounds, and compares it with the ultimate strength given by deformed bars under the same conditions, taken from a formula for figuring the carrying power of same, as given in a catalogue of one of the manufacturers of this type. The result showed

that the plain bars in the building tested were carrying four times what the deformed bar advocates figured the ultimate strength of their type, without injury to the construction.

Mr. Turner is the designer of the Mushroom System of reinforced concrete construction which has been used with great success in a number of buildings which he has erected, and notably the Hoffman building in Milwaukee, which as been widely written up in the technical press. This interesting method makes it possible to obtain a flat ceiling in a reinforced concrete constructed building with columns spaced 16 to 20 feet apart without imposing greater loads on the pier and wall foundations than would be given by the ordinary beam and slab construction.

While at the present time Mr. Turner uses the plain bar in this system of construction, he very clearly states in his article that he has no interest in any type of bar further than the question of economy and safety, and if he can be shown that any type of deformed bar possesses that degree of toughness and uniformity which he would demand in steel construction, together with an adequate advantage commensurate with its increased cost, he would be interested, and unquestionably influenced in writing the specifications for from 10,000 to 12,000 tons of metal for concrete work which he is called upon to do in the course of the season's work.—*Ryerson's Monthly.*

The Mills in South African Practice.

AN interesting contribution on the subject of the Practical Operation of the Tube Mill, was made by Mr. S. S. Osborn, in the Journal of the Chemical, Metallurgical and Mining Society of South Africa, June issue.

"When ores are heavily charged with Marcosite, as in the case of the Glen Deep and the Robinson Deep Mines, fine grinding has to be resorted to, and, according to the author, every effort should be made to grind all pulp sufficiently fine to allow of its passing through a 60-mesh screen. He states that, as far as the feed end of the tube mill is concerned, where the outlet of the mill is much larger than the inlet, nothing need be added to prevent the pulp from flowing out at tne inlet end. On the other hand, however, where there is not much difference in the size of the inlet and the outlet, there is a tendency for the pulp to pass out at the feed end, and, therefore, the gland and top feed were adopted in the Allis-Chalmers mill, of which it is a special feature."

In most cases the tonnage passing through the tube mill, is larger than the total tons crushed by the stamps, due to the larger quantity of pulp in circulation.

Based upon the excellent results from the use of the tube mill, there has been a growing recognition of its value in the South African field. The following citation will show how these results, brought about by its introduction there, have established the use of the tube mill on an independent footing:

Tube Mills Adopted by the Glen Deep Mines.

At a meeting of the Glen Deep, Ltd., in Johannesburg, South Africa, the results of careful tests, made at the principal mines in the Rand as outlined in Allis-Chalmers Company's special bulletin on this subject, were

Automatic loading bucket is provided with partition and can be shoveled into from both sides of machine.

Drum discharges into special bucket for conveying concrete.

The bucket travels on an I beam track and can be stopped and discharged at any point.

The "I" beam track is 24 feet long, but can be made longer if desired. It is connected to frame with a universal joint and can be swung from one side of street to the opposite side and can also be elevated 45 degrees.

When using it on street work the bucket delivering the concrete will partially spread it.

The saving in labor is considerable as all wheeling is eliminated.

Capacity of machine is 22 to 25 cubic feet to a charge and will mix 300 cubic yards in 10 hours.

It is furnished with gasoline, steam or motor power.

News Items.

H. M. North, engineer in charge of construction of the L. S. & M. S. Ry., has awarded the contract for the concrete piles for the footings of the Cuyahoga viaduct of the Shore Line road to the Raymond Concrete Pile Company, of Chicago and New York.

The American Railways Company, through A. S. Kibbe, engineer, have awarded the contract for the foundations of the power house of the Home Electric Light & Power Co., at Tyrone, Pa., to the Raymond Concrete Pile Company, of Chicago and New York.

The Trill Indicator Company, Corry, Pa., are sending out a circular advertising the Triumph Indicator. They ask no one to take chances on their products, but will send them to any responsible person for ten days' free trial. If not exactly as represented, same to be returned at their expense.

Dodge & Day, engineers and constructors, of Philadelphia, have submitted a betterment report covering the entire factory of Fayette R. Plumb, Inc., of Frankford, Pa., and are now engaged in making extensive alterations to the forge shops. When this work is finished other departments will be taken up and ultimately the entire plant will be remodelled.

One of the most recent of the contracts announced by the Frank B. Gilbreth organization, calls for the erection of a new factory building for the H. C. White Co., manufacturers of stereoscopes and stereographs, at North Bennington, Vt.

The building, which will be erected under the Gilbreth Cost-Plus-a-Fixed Sum contract, will have brick walls, with concrete floors, beams, roofs, girders and columns, at a cost of approximately $35,000. The engineer is W. F. Dean, of Boston.

The Standard Roller Bearing Co., of Philadelphia, Pa., has increased its capital of $3,500,000 to $5,000,000. Large additions are now being made to the plant and equipment for the purpose of enlarging their department for the manufacture of roller bearings for shafting hangers and also for the establishment of an entirely new department for the manufacture of roller bearings for trolley cars.

The saving by the use of roller bearings on trolley cars amounts to about $300 a year per car and the demand is so great that a large addition to their plant is required to take care of its business.

Mr. Fred H. White, formerly correspondent for the Pope Mfg. Co., of Hartsord, has accepted a position with Mr. R. B. Jacobs, secretary of the Jacobs Mfg. Co., Hartford, who is promoting the First Annual Hartford Industrial Show to be held in Foot Guard Hall December 16-21, 1907. During this week the leading manufacturers of New England will have goods on exhibition, and about 25,000 complimentary tickets will be issued to mechanical men in New England, so that all may see the latest improvement and new products of such firms as Pratt & Whitney Co., the Henry & Wright Mfg. Co., Dwight Slate Machine Co., Carlyle Johnson Machine Co., etc.

A Correction.

It is regretted that the name of C. O. Bartlett & Snow Co., Cleveland, was not given in the October issue in the article on "A Rapid Fueling Spstem," as the builders of the elevating and conveying machinery for this vessel. This vessel was designed and equipped throughout by the above firm.

The Industrial Magazine will be raised in price to $2.00 January 1st, 1908.

State Drainage Engineer George A. Ralph, of Maryland, has announced that a huge drainage ditch would be constructed across the great watershed of North America, connecting Boustring and Round Lakes, Itasca county. Plans for that work have been prepared. Water from Boustring flows into Hudson Bay, and Round Lake drains into the Mississippi River.

The ditch will be six feet deep and will permit navigation of canoes from Hudson Bay to the Gulf of Mexico.

Owing to the many recent strikes on the part of mill hands and railroad operatives throughout the Mexican republic, the government has decided to take drastic action against the leaders and agitators in all cases in which the men are advised to walk out for trivial causes. If after investigation the government is convinced that the calling of a strike is a mere means to attain ascendancy over the employer, the striking workmen and the leaders will be sent to prison on the Island of Las Tres Marias, in the Pacific ocean, 100 miles off the coast of the Tepic territory. This island is used as a colony for desperate criminals.

A group of manufacturers in the iron trade at Erie, Pa., have established the Manitoba Iron Rolling Mills Co. at Winnipeg, Canada. The mill and the puddling furnaces are now in operation, using large quantities of scrap iron. It is the only iron mill in Canada between Port Arthur and the Pacific coast. Another new plant has gone into service at Port Arthur, which is using exclusively Manitoba ore. This mill is paid a bounty of $2.10 a ton by the Canadian government. Mills which use American ores receive a bounty of $1.10 a ton. At the present time the Dominion government is paying bounties at the rate of nearly $3,000,000 a year on the production of iron and steel.

Preliminary work has been begun on a large power dam on the Sacandaga river, in the northern part of New York state. When it is completed a lake will be formed forty miles long and three miles wide, which will give out about 200,000 horse power. The dam, it is calculated, will be about a mile long and 100 feet high at its highest point, and will be built of solid masonry. Its power will be used in conjunction with that of Spiers Falls power plant, which is several miles below the mouth of the Sacandaga river, which empties into the Hudson river. Already the big dam at Spier Falls, the fourth largest dam in the world, and probably the largest dam constructed exclusively for power purposes, is taxed to provide energy enough to meet the requirements. The radius of influence of Spier Falls, narrow at first, gradually spread, until now its power runs the street cars in Albany, Watervliet, Schenectady, Rensselear, Cohoes and Waterford; lights the streets in many of those communities and furnishes power for many manufacturing plants. The greatest factor that has decided the development of the Sacandaga power is the application of electricity to the railroads of the state.—*Practical Engineer, Philadelphia, Sept.*

An engineering feat deserving mention has been accomplished by the undergraduate engineers of the Colorado Agricultural College. This was running a line of levels to the top of Long's Peak, which for many years it was thought impossible to ascend. The upper part of the peak is an immense granite boulder, about half a mile long, and 500 feet high. On one face is a precipice of 2,600 feet. The ascent was finally made by starting on the northeast corner and passing completely around the peak, part of the way on a narrow shelf and finally reaching the top in a crevice on the southeast corner. The students connected with a bench mark of the Union Pacific railway in Estes park, and ran a duplicate level for a total distance of about 16 miles horizontal distance and nearly 7,000 feet vertical difference of level. Since then the United States Geological Survey has run a double line of levels, one via Longmont and one via Loveland, connecting with the work on the plains, and finally with the line of precision levels of the United States Coast Survey. The height of the peak as finally determined, is 14,255 feet above sea level. The work of the Hayden survey has universally been recognized as being very good. This is shown by the fact that the elevation of the Peak as given by Hayden is 14,274 feet, a difference of only about 19 feet in elevation. Long's Peak is probably the only peak where a line of spirit levels has been run to the top. There is no comparison in the difficulty of ascending and running levels over the two peaks.—*Engineering Record*, Sept. 14, '07.

In America workmen are not even yet willing to say that opposition to labor saving machinery is fundamentally wrong, and possibly even in England the doctrine is still not widely accepted. The address of Arthur Henry Gill, M. P., at the English Trade Union Congress held in Bath in September, of which congress he was president, is, however, sufficiently conclusive proof of the trend of English labor thought on the subject.

Mr. Gill argued that no effort should be made to check the use of labor saving appliances. But on the ground of economic theory and of history Mr. Gill's position is impregnable. According to the London Spectator his view was accepted by the congress as thoroughly sound, and it probably represents the opinion of the most enlightened labor leaders on the other side. The battle is still waging fiercely in this country, however, and it will continue to do so until labor realizes that it is fighting against one of the irresistable forces of nature.

"If the history of the factory movement proves anything," says the New York Evening Post editorially, "it proves that the economic forces which impel men to use machinery whenever it is cheaper than hand labor are absolutely irrepressible. If there is any one fact with which a labor leader should be familiar, it is that. If there is any one truth which Mr. Gompers and his associates should spend their days and nights in impressing upon their followers, it is that those who contend against the immutable laws of the development of civilization, like those who appeal to violence instead of reason, are fore-doomed to defeat."

This mistaken idea regarding the output and efficiency of machinery has been the cause of many battles between employers and employes, but now that light is beginning to break, we can look for a gradual decrease in such disputes. Here again the interests of both parties are identical, and in the recognition of this fact and others similar, lies one of the most hopeful signs of the improvement of labor conditions.

Bibliography.

The Department of Industrial Betterment will be glad to send postpaid to readers of the books mentioned, on receipt of their list price.

RAILROAD ACCIDENTS, THEIR CAUSE AND PREVENTION, by R. C. Richards, General Claim Agent of the Chicago & Northwestern Railway Company. Published by the Association of Railway Claim Agents. Pages, 111. $1.00.

Among everything which has been published on the subject of railroad accidents, this little book seems to us to fill one of the most important places. It is written by one whose daily work is that of adjusting claims for accidents and who must therefore be in position to judge as to their real cause and the most effective methods of prevention.

The book is in the form of a communication to the employees of the Chicago & Northwestern Railway and takes up, first, The Cause of Accidents, under the sub-headings of injuries to passengers, to tresspassers, and to others who have some legitimate reason for being on the railroad property, such as those passing over highway crossings, after which it discusses the cause of injuries to employees. Derailment, Defective Equipment, and Carelessness are given minute attention and the general impression after reading the book is that the greatest of all these is carelessness.

Mr. Richards then goes on to present some very valuable suggestions for the prevention of accidents. "And so I might go on," he says, "detailing the various accidents that have occurred from the carelessness of employees, but I believe I have enumerated enough of them to illustrate the point I wish to make; that is, the employee is too careless, thoughtless and negligent; and I hope also to demonstrate that the larger part of them could be avoided and that a united effort should be made by all to prevent them in the future. It does not require any argument to prove that the many accidents resulting every day, and the resulting injuries and destruction of property, ought to be reduced, and that, if the rules were complied with and proper care and supervision exercised in transacting the business of the companies, their number and consequent money loss would be materially reduced; and it is up to the employees to do their share to bring about this necessary result. Railroads that advertise that they have the best of everything—including men—that have spent not thousands but millions for safety devices and appliances, as many of the lines have, ought to be able to make a better record; and I believe when employees really understand the matter such roads will be where they belong—at the head of the procession, not only so far as freedom from accident is concerned, but in evertything else."

opinion in the economic world. These letters are printed in this study and furnish the basis of the discussion. Anyone who will take the trouble to read two or three times over the answers of each of the classes, will find growing upon him the composite photographs of the minds of the employers and the employed at the present time.

"The following, it seems to me, are the most important facts revealed by present-day study of the labor question:

"1. There is a mutual interest between the workingman and his employer. That mutual interest consists in securing the largest and cheapest production of useful commodities.

,"2. The adverse interest of employer and employed results necessarily in conflict. . . . . It seems apparent that the organizations, both of employers and of employed, are in the interests of lawful combat.

"3. The adverse interest of employer and employed is in the distribution of the product arising from their mutual industrial co-operation.

"4. In the last analysis, labor conflicts must be carried on under rules formulated by the State. The State, as the most authoritative organ of social life, must be depended upon to secure justice to all parties."

Dr. Smith points out that there are three parties interested in all labor disputes and in all movements to improve the condition of labor, as well as to conserve the interest of the employer. These three parties are the employer, the employee, and the general public, and the interest of the last is by no means minor.

Socialism will not do. "Socialism is an assault upon the nation. It is essentially anti-patriotic. It asserts its kinship with all men in a communion of sympathies which is world-wide. Those people who love everybody in an effusive manner, that they love no one better than another, in reality never love at all. Home, friends, country, are not words alone. They are means of self-expression and of self-development. It is by the privacy of home against home that the security of the personal life is insured. It is the men who love their own country best who may be trusted to admire most what is good in every other country, and to seek to incorporate in it their own institutions; it is those who appreciate the value of definite and personal kinship who can be trusted to sympathize most keenly with the brotherhood that is world-wide."

Dr. Smith, who, by the way, is a member of the Department of Sociology of the University of Minnesota, is trained in scientific habits of thought, and he goes at this subject scientifically and sanely, with the result of a very valuable contribution to present day literature on labor disputes.

UP FROM SLAVERY, by Broker T. Washington, Doubleday, Page & Co. New York, Pages xxiii, 330. $1.50.

Justice David A. Brewer, of the United States Supreme Court, in his address before the American Missionary Society in Cleveland on October 14, took up the subject of the American Negro. "Here is one ninth of our population," he said, "coming out from the ignorance and immorality of slavery. We are making it uplift our business. We are striving to train the hand and the mind and to fill the heart with a love of purity and a sense of the beauty of holiness."

A matter which concerns not only one ninth of the population of this country, but also all of the others with whom these people come in contact, including all of the inhabitants of the Southern states, as well as many others, is worthy of the most careful attention. The story of Brooker T. Washington's boyhood days and of his struggles since to place industrial education and greater opportunities of every sort before the people of his color should be familiar to every one who is interested in the improvement of the colored man's lot.

its satisfactory performance as a whole. It should therefore be clearly understood at the outset just what the extent or the limitations of responsibility of the engineer are to be. Whether he has been employed merely as a designer or whether he is retained to design and to superintend construction; whether to design only the chief features, or to pass as well upon the details of the apparatus that is to be installed. Attention should be directed to the fact that defects in the manufacture of material or apparatus is a matter distinct from the matter of design or installation. An engineer should not be responsible for the unsatisfactory performance of a plant resulting from defective apparatus furnished, unless he has undertaken to include the subject."

With regard to the ownership of the records of the electrical engineer, the code states:

"If in executing his work, the electrical engineer uses data or information which are not common and public property, but which he receives, directly or indirectly from his employer, and is not of such character that his attention would have been directed to it regardless of his relations to his employer, the products of his work, in the form of inventions, plans, etc., are not his private property, but the property of his employer, though the engineer may be entitled to special remuneration for such inventions, etc.

"If in the execution of the work the engineer uses only his own knowledge or data or information which are public property by prior publication, etc., and receives no engineering data from his employer or customer, except performance specifications, the results of his work, such as inventions, plans, designs, etc., are the private property of the engineer, and his employer or customer is entitled to their use only in the specified case.

"All the work done by the engineer in the form of inventions, plans, designs, etc., which are outside the field of engineering for which his employer has retained him are the engineer's private property.

"When an engineer or manufacturer builds apparatus from engineering designs supplied to him by his customer, the designs remain the property of the customer and should not be duplicated for other customers without express permission. When the engineer or manufacturer and his customer are jointly to work out designs and plans or develop inventions, a clear understanding should be arrived at before the beginning of the work regarding the proportionate rights of ownership in any inventions, designs, etc., that may result, since in such case both parties should be considered to have rights therein.

"Any engineering data or information which an electrical engineer obtains, directly or indirectly, from his employer or customer, or which he creates as a result of such information, must be considered by the engineer as confidential; and while the engineer is justified in using such data or experience in his own practice as going toward his education, the publication thereof without express permission is improper, as is also its use in producing, for other parties, work that is characteristic of the original customer or employer.

"Designs, data, records and notes made during his engagement, by an engineer employed under permanent engagement, and referring to his work, are his employer's property. The same matters in the case of a consulting electrical engineer are the property of the consulting engineer.

"A customer, in buying apparatus, does not acquire any right in its design beyond the use in the apparatus purchased. A customer of a consulting engineer does not acquire any right to the plans made by the consulting engineer except for the specific case for which the apparatus was built or the plans made."

The proper relations of the electrical engineer to the general public are specified thus:

"The electrical engineer should endeavor to assist the public to a fair and correct general understanding of engineering matters, spread the general knowledge of electrical engineering, and discourage wrong or exaggerated statements on engineering subjects published in the press or otherwise, especially if these statements are made for the purpose of, or may lead to inducing the public to participate in unworthy schemes.

"Controversies on engineering questions, however, should never be carried on in the public press, but should be confined to the technical press and the engineering societies.

"First publication of inventions or other engineering advances should not be made through the public press, but rather through the technical press and the engineering societies.

"The publications which an electrical engineer is justified in making through the public press should therefore be of a historical, educational, instructive or similar character and should not relate to controversies between engineers or on engineering questions,

It will not add to the cost of construction in cement to effect this, but rather result in economies through greater efficiency and better progress alone. The same proportion of unskilled or common labor may be used, only we should seek to train and improve it, and always keep it under competent supervision in constant attendance.

The general public—architects, engineers and contractors—must be brought to recognize the fact that while cement in concrete construction is a very important element, nevertheless, the other materials with which it is combined and the manner of mixing and placing the materials and the forms to contain them are also of prime importance, and should be submitted to the same inspection, preliminary tests and approval of competent authority as may usually be required of the cement.

The proportion of sand to cement should never be fixed in advance of sufficient knowledge of the character and quality of sand available for the work in hand; if this be found inconvenient or seemingly impractical, then the proportions should be open to easy adjustment and should be provided for in advance in the contract. Available and proposed sand should always be tested and compared with some recognized standard before use.

The public demand for cement construction cannot be met at this time, not for want of cement, but because we have relatively so few builders and contractors qualified by experience to undertake this class of work; and, showing the cumulative effect of such a condition, this fact has in a large measure prevented architects from designing in concrete and urging its adoption for residential uses.

A most promising and encouraging feature in the industry, however, is the organization of construction companies, officered by engineers and experienced contractors, who are making a specialty of concrete work, and it is perfectly reasonable to expect that their efforts will result in further improvements and economies in ways and means, also in the appearance and quality of finished exposed surfaces; a field affording great possibilities and much promise already.

In the flush of their first successes, however, let these companies pause and consider the danger of allowing their work to grow beyond their capacity to properly direct and control.

The cement industry cannot rest satisfied with a national interest in the product at this time, but must create even a broader confidence by the encouragement of prudent and rational safeguards, lest their omission be followed by unfair and discriminating restrictions on the part of local municipal building commissions.

Trade jealousies are keen and alert, and every failure or disappointment in concrete construction, however infrequent or unimportant, is amplified and accentuated.

It was thought at first that this publicity would seriously retard the progress of the new industry; but not so, and this fact can only be taken as further evidence of the wonderful vitality of this form of construction. It has also come to be generally known and admitted, as a result of rigid and thorough investigation, that each instance of failure has been the result of ignorance or criminal carelessness, and almost without exception, has occurred during construction. Is any material of construction proof against such causes?

The score upon scores of splendid examples of concrete construction, in all departments of engineering work, and among all classes of buildings, leave no room for doubt of its success from the standpoint of adaptability, appearance, economy and durability, under conditions of exposure that no other material now used in construction can so successfully and economically meet.

The greatest economy and best results structurally and architecturally, however, cannot be obtained, except by competent design and intelligent sympathetic treatment of outline and texture, with due regard to environment, exposure and available materials composing the aggregates, of which we have an endless variety, by selection and combination; and then the work of construction must have the equivalent in intelligent and honest supervision that any reputable job receives; in fact, it might have even more and still cost less than is represented in the person of the boss carpenter, boss brickmason, general foreman, sub-foreman and superintendent, all of whom are in constant attendance.

No other department of the cement industry has so felt the need of standard specifications and uniform instructions as we find in the manufacture of cement blocks.

There is today a large and growing demand for this material, and its general and almost unlimited use is only retarded by lack of confidence on the part of architects, builders and resident owners who see only the wretched re-

proportions of good sand that may be added to cement.

Sand, or the fine aggregate, shall be suitable silicious material passing the one-fourth inch mesh sieve, and containing not over ten per cent. of clean, unobjectionable material passing the No. 100 sieve. A marked difference will be found in the value of different sands for use in cement mortar. This is influenced by the form, size and relative roughness of the surface of the sand grains, and the impurities, if any, contained. Only clean, sharp and gritty sand, graduated in size from fine to coarse and free from impurities, can be depended upon for the best results. Soil, earth, clay and fine "dead" sand are injurious to sand, and at times extremely dangerous; particularly in dry and semi-wet mortars, and they also materially retard the hardening of the cement. An unknown or doubtful sand should be carefully tested before use to determine its value as a mortar ingredient. Screenings from crushed trap rock, granite, hard limestone and gravel stones are generally better than bank sand, river sand or beach sand in Portland cement mortars (but not so when used with natural cement, unless the very fine material be excluded).

So-called clean, but very fine sand, has caused much trouble in cement work, and should always be avoided, or if impossible to obtain better, the proportion of cement should be increased. Stone screenings and sharp, coarse sand may be mixed with good results, and this mixture offers some advantages, particularly in making sand-cement blocks.

For foundations or superstructure walls exposed to weather, carrying not over five tons per square foot, the maximum proportion shall not exceed four parts sand to one part cement. This proportion, however, requires extreme care in mixing for uniform strength and will not produce water-tight blocks. We recommend for general work not over three parts sand, if well graded, to one part cement, and the further addition of from two to four parts of clean gravel stones passing the three-fourths inch sieve and retained on a one-fourth inch mesh sieve, or clean screened broken stone of the same sizes. These proportions, with proper materials and due care in making and curing, will produce blocks capable of offering a resistance to crushing of from 1,500 to 2,500 pounds per square inch at twenty-eight days.

(For the best fire-proof qualities limestone screenings or broken sizes should be excluded, but otherwise are all right for use.)

Where greater strength is desired, particularly at short periods, from two to six weeks, we recommend the proportions of one part cement, two parts sand, and from one and one-half to three parts gravel or broken stone of sizes above given. Blocks made of cement, sand and stone are stronger, denser, and consequently more water-proof than if made of cement and sand only, and are more economical in the quantity of cement used.

Mixing. The importance of an intimate and thorough mix cannot be overestimated. The sand and cement should first be perfectly mixed dry and the water added carefully and slowly in proper proportions, and thoroughly worked into and throughout the resultant mortar; the moistened gravel or broken stone may then be added either by spreading same uniformly over the mortar or spreading the mortar uniformly over the stones, and then the whole mass shall be vigorously mixed together until the coarse aggregate is thoroughly incorporated with and distributed throughout the mortar.

We recommend mechanical mixing wherever possible, but believe in the thorough mixing of cement and sand dry before the addition of water; this insures a better distribution of the cement throughout the sand, particularly for mortar used in machine made blocks of a semi-wet consistency. For fine materials, such as used in cement blocks, it is necessary that the mechanical mixer be provided with knives, blades or other contrivances to thoroughly break up the mass, vigorously mix the same and prevent balling or caking.

Curing. This is a most important step in the process of manufacture, second only to the proportioning, mixing and moulding, and if not properly done will result either in great injury to or complete ruin of the blocks. Blocks shall be kept moist by thorough and frequent sprinkling, or other suitable methods, under cover, protected from dry heat or wind currents for at least seven days. After removal from the curing shed, they shall be handled with extreme care, and at intervals of one or two days shall be thoroughly wet by hose sprinkling or other convenient methods. We recommend curing in an atmosphere thoroughly impregnated with steam. This method serves to supply needed moisture, prevent

most any location, and all this is of easy attainment.

Let the intending manufacturer of machine-made blocks remember that the machine is simply a mechanical convenience, and it remains for him to use proper materials, correct and accurate methods of proportioning, mixing, moulding and curing, to study and meet the demands of the building trade, and keep abreast and a little in advance of the other fellow in this progressive age.

Stream Measurements.

BY CYRIL C. MAISON.

IN the execution of projects for development of water power, and in the control and management of water powers, the necessity is constantly arising for determining quantities of water. The measurement of the absolute volumes of water in a reservoir, of any kind is a matter of little difficulty, being a simple geometrical computation. The question is usually as to the flow of water, i. e., the quantity of water passing a fixed point in a given time, involving the unit of time, as well as the unit of volume. The second is usually taken as the unit of time, and the

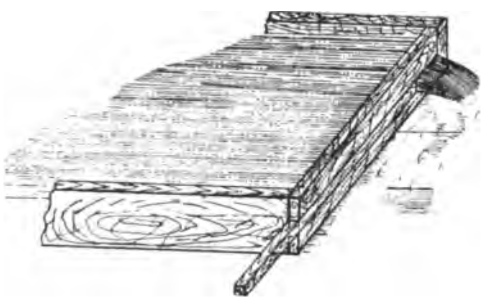


Fig. 1.—Miner's Inch.

cubic foot as the unit of volume, in all questions relating to water power, the problem being to determine the number of cubic feet of water flowing in one second. Two general classes of methods are available: First, the quantity of water flowing in a channel; second, the quantity flowing from a weir. An approximate idea of the flow of a natural stream will be taken into account and the methods used in measurement. The velocity of a stream can be found by laying off a 100 feet or more on the bank, and throwing a float in the middle, noting the time taken in passing over the measured distance on the bank. Do this several times and take the average; then, dividing this distance by the time, gives the velocity at the surface. As the top of the stream flows faster than the bottom and sides, the average velocity being about 83 per cent of the surface velocity at the middle, it is convenient to measure a distance of 120 feet for the float and reckon it as 100. To have as nearly as possible correct measurements select a stretch on a stream which will afford as straight and uniform a course as possible. But we want the cross section, therefore we measure at from 6 to 12 points across the stream at equal distances between them. Add all the depths in feet together and divide by the number of measurements made. This will be the average depth of the stream, which multiplied by its width will give its area or cross section. Figure 2 illustrates this. Multiply this by the velocity of the stream in feet per minute, and the result will be the discharge in cubic feet per minute of the stream. Fig. 1 shows the form of measuring and one ordinarily used for the Miners Inch Measurements. This term is more or less indefinite for the reason that water companies, in measuring water to their consumers do not

	Openings 2 Inches High			Openings 4 Inches High		
Length of Opening in Inches	Head to Center 5 Iuches.	Head to Center 6 Inches.	Head to Center 7 Inches.	Head to Center 5 Inches.	Head to Center 6 Inches.	Head to Center 7 Inches.
	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.
4	1.348	1.473	1.589	1.320	1.450	1.570
6	1.355	1.480	1.596	1.336	1.470	1.595
8	1.359	1.484	1.600	1.344	1.481	1.608
10	1.361	1.485	1.602	1.349	1.487	1.615
12	1.363	1.487	1.604	1.352	1.491	1.620
14	1.364	1.488	1.604	1.354	1.494	1.623
16	1.365	1.489	1.605	1.356	1.496	1.626
18	1.365	1.489	1.606	1.357	1.498	1.628
20	1.365	1.490	1.606	1.359	1.499	1.630
22	1.366	1.490	1.607	1.359	1.500	1.631
24	1.366	1.490	1.607	1.360	1.501	1.632
26	1.366	1.490	1.607	1.361	1.502	1.633
28	1.367	1.491	1.607	1.361	1.503	1.634
30	1.367	1.491	1.608	1.362	1.503	1.635
40	1.367	1.492	1.608	1.363	1.505	1.637
50	1.368	1.493	1.609	1.364	1.507	1.639
60	1.368	1.493	1.609	1.364	1.508	1.640
70	1.368	1.493	1.609	1.365	1.508	1.641
80	1.368	1.493	1.609	1.366	1.509	1.641
90	1.369	1.493	1.610	1.366	1.509	1.641
100	1.369	1.494	1.610	1.366	1.509	1.642

all use the same head above the center of the aperture, and this inch varies from 1.36 to 1.73 cubic feet per minute. The most universal measurements, however, are obtained through material 1¼ inches thick, and the lower edge 2 inches above the bottom of the measuring box, thus giving full contraction.

The Status of the Draftsman.

FROM several points of view, the draftsman occupies a more peculiar position in the modern shop than many of the other workers who make up the organization. The draftsman is considered by many a manager as a kind of necessary evil, a dead expense, which he cannot avoid. For behold! the drafting room is a non-productive department. At the same time the drafting room of any well-organized shop is recognized as the heart of the industrial end of the business, in which the planning and systematizing forces, at least to a large degree, are located. The draftsman himself occupies a very different ground in different shops, according to whether the former or the latter view expressed is the prevailing one in a particular organization. Of course, there are draftsmen and draftsmen. There are those that are valued at $10 a week or less, and those that are valued at $40; and this fact, too, tends to place the knight of the T-square in a peculiar position. There are no very well defined limits to his trade. He is more or less what one might call a free lance. In many a case he is not even a distinct part of the regular organization. He is called in when a new design is to be turned out in the drafting room, and when that is done he is "laid off." At least, this is the case in the majority of smaller shops, specializing on one or a few kinds of standard machines. The last contention may, perhaps, not apply to the leading designer, but it most certainly applies to the ordinary draftsman.

The conditions outlined are by no means very satisfactory, but it is difficult to propose a remedy. It has been suggested that men in the shop, having training in drafting, be temporarily taken into the drafting room to help out when business there is pressing, rather than to hire draftsmen for short terms. But this course would be subject to many objections. In the first place, nobody does the draftsman's work as well as a trained draftsman, constantly working at his trade. In the second place, it is not at all sure that the very men with drafting experience, wanted from the shop, can be spared there at a particular time, and last, but not least, the man, who at first would be only temporarily taken from the shop for drafting room work, would soon find a certain attraction in his new occupation, and, in nine cases out of ten, he would not return to the shop again, but continue on what, at first sight, seems to him the rosy road of the draftsman. To the ordinary shop worker, the drafting room has at first many attractions. The work is cleaner, the duties, at first, less exacting, the surroundings more pleasing, and the hours generally shorter. In the long run, however, it is evident that the draftsman, having passed through the stages of assistant to that of independent designer, finds the limitations greater in this department than in the productive departments in the shop. That is why we find so few old draftsmen. We do not realize where they go to; all we know is that they disappear from the drafting board as they grow older.

The cause for this is perhaps the kernel of the matter of the comparatively unsatisfactory status of the draftsman. After long years of close attention to business, he has become an expert designer, and his work requires all the mental qualities present only after years of training and experience. His general intelligence, measured in units of logic, is greater than that of most of his co-operators in the industrial organization. He is the ingenious planner and schemer of profit-making devices, and even though, in certain cases, some ideas are furnished him by "the man higher up," these ideas, as a rule, are furnished in such a crude form that the draftsman is but little helped in his work. When the device is completed, however, the honor of the successful working does, curiously enough, not fall upon the one to whom the most of the credit is due. When we

also consider that the compensation paid to the most skillful of machine designers is often, not to say nearly always, less than that of department foreman, many of whom in intelligence and general ability are far inferior to a trained designer, then it is easily seen why we find the draftsmen leaving the chosen trade, as soon as they have reached middle age, to seek more congenial occupations. This, however, is a distinct loss to the industries as such. The best and ablest men, the most experienced designers, are lost to the craft at the very time when their services would become most valuable. If the draftsman were considered a more integral part of a shop organization, if his merits were recognized, rather than usurped, by his superiors and if his compensation stood in a more equitable proportion to his achievements, he would be less tempted to leave that place in the industrial organization where he serves the best, for other occupations, far better compensated, but requiring no more intelligence, judgment or ability.—*Machinery.*

Formula for Sprocket Wheels and Gear Teeth.

THE Union Twist Drill Company, Athol, Mass., have published some formulae on sprocket wheels which may be of interest to our readers.

The following is for calculating diameters of sprocket wheels for block center chains:

N = No Teeth.

b = Dia. of Round Part of Chain Block.

B = Center to Center of holes in Chain Block.

A = Center to Center of holes in side links.

$$a = \frac{180°}{N}$$

$$\operatorname{Tan} \beta = \frac{\sin a}{\frac{B}{A} + \cos a}$$

$$\text{Pitch Diam.} = \frac{A}{\sin \beta}$$

Outside Diam. = Pitch Diam. + b.

Bottom Diam. = Pitch. Diam. — b.

In calculating the diameters of sprocket wheels the bottom diameter is the most important.

The following for calculating diameters of sprocket wheels for roller chains:

N = Number of teeth in sprocket.

P = Pitch of Chain.

D = Diam. of Roller.

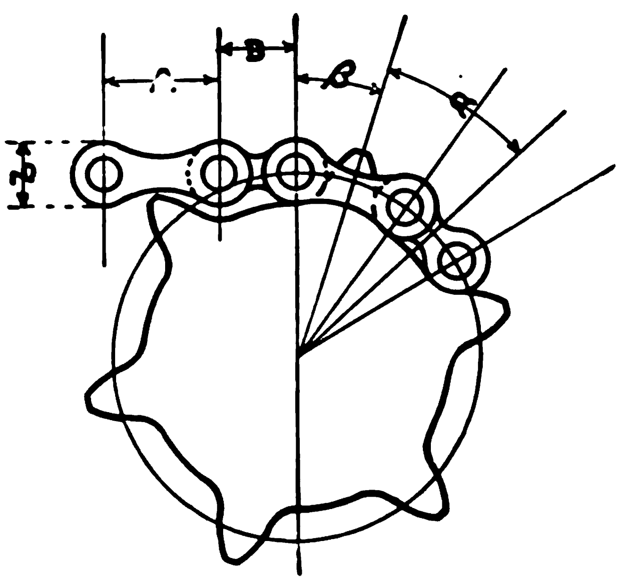
$$a = \frac{180°}{N}$$

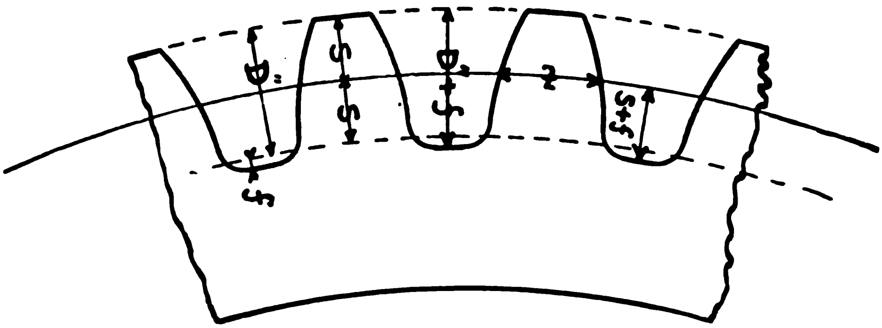
$$\text{Pitch Diam.} = \frac{P}{\sin a}$$

Outside Diam. = Pitch Diam. + D.

Bottom Diam. = Pitch Diam. — D.

They have also published formula for determining the dimensions of gears by metric pitch.





They use a ***module*** which is the pitch diameter in milimeters (mm), divided by the number of teeth in the gear.

Pitch diameter in mm. is the module multiplied by the number of teeth in the gear.

M = Module.

D=The pitch diameter of gear.

D = The whole diameter of gear.

N = The number of teeth in gear.

D" = The working depth of teeth.

t =Thickness of teeth on pitch line.

f = Amount added to depth for clearance.

Then

$$M = \frac{D^1}{N} \text{ or } \frac{D}{N+2}$$

$D' = NM$

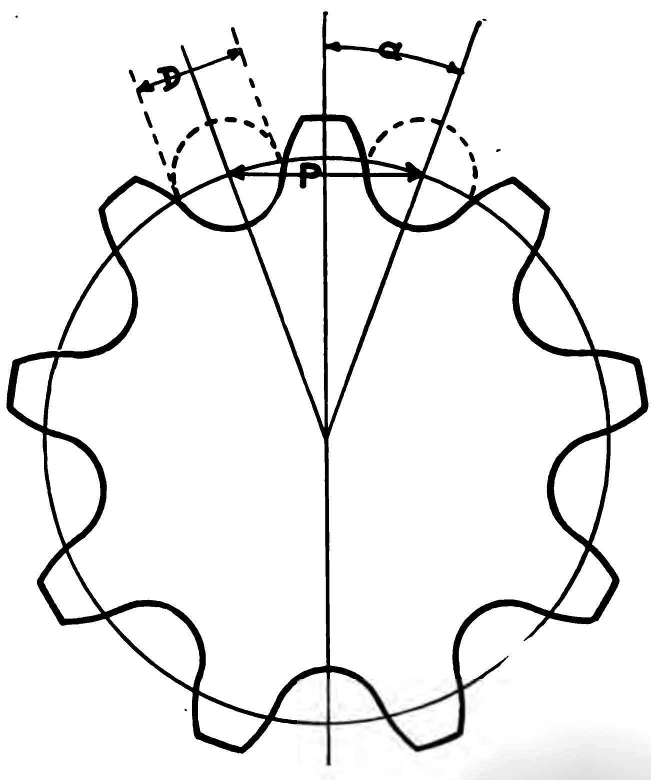
$D = (N + 2)\ M.$

$$N = \frac{D^1}{M} \text{ or } \frac{D}{M} - 2.$$

$D'' = 2M.$

$t = M\ 1.5708.$

$$f = \frac{M\ 1.5708}{10} = .157\ M.$$



The module is equal to the part marked "S" in cut, on following page measured in mm. and parts of mm.

MODULE IN MILLIMETERS.

Module	Corresponding English Diametral Pitch	Module	Corresponding English Diametral Pitch
½ mm	50.800	4.5	5.644
¾	33.867	5.	5.080
1	25.400	5.5	4.618
1.25	20.320	6.	4.233
1.5	16.933	7.	3.628
1.75	14.514	8.	3.175
2	12.700	9.	2.822
2.25	11.288	10.	2.540
2.5	10.160	11.	2.309
2.75	9.236	12.	2.117
3	8.466	14.	1.814
3.5	7.257	16.	1.587
4	6.350		

Mechanical Draftsman and Designer.

All firms have a drafting room system of some kind; even the little plant, where the entire drafting room force consists of one man, who either uses some scheme he has learned while working for a larger company, or else numbers the plates according to the method he followed when learning to draw.

The writer was in a position of this kind at one time where a standard size sheet was unknown and where the paper was rough may be bought in rolls thirty-six inches wide and several yards long. When a drawing was to be made the paper was unrolled and a sheet as large as necessary cut out.

The drawing when finished usually had to be sent out into the shop without even a coat of shellac. Once in a while one would be returned from the shop; but usually they got so dirty that it wasn't thought worth while returning them, and they were destroyed, thus destroying all record of the work.

After getting fairly settled I made an effort to change all this, and to systematize the engineering department (?). First in order that the drawings might be filed easier I determined to work to four standard sizes to be designated by the letters A, B, C, D. The A size was 24 inches by 36 inches and was used chiefly for assemblies; but in cases where the pieces were very large it sometimes became necessary to use this size for detailing. The B size was 18 inches by 24 inches and was used both for details and assemblies, several details being placed on one sheet. The C size was 12 inches by 18 inches and was confined almost wholly to details. The D size was 9 inches by 12 inches and used for details where there was one piece to a sheet. In choosing these sizes I simply took what is standard in a good many shops, and, as did the other plants, I soon found another list of numbers was needed to cover miscellaneous sketches, etc. These took a number with no letter following, but an effort was made to make as few sketches as possible even going so far as to paste an odd size sketch sent in by some outsider on a drawing sheet coming the next larger size.

The numbers, I kept all in one book ruling it off as in Fig. 1. First a description of the drawing is given. Next the serial number appears, this number being taken out in serial order regardless of the size, which is given

DESCRIPTION	NO.	SIZE	DFTS.	DATE	REMARKS
Eccentric Strap & Rod	128	B	D.J.S.	10-1-02	4×4 Vert. Eng.
Steam Chest Cover	129	B	D.J.S.	11-1-02	" "
4×4 Vert. Eng. Erection Dwg	130	A	EMK	11-8-02	
Crankshaft 4 HP Gas Eng.	131	—	E.W.O.G.	11-10-02	Their No. 1704
" Special	132	A	EMK	11-20-02	12×24 Hor Eng
	133				
	134				
	135				

FIG. 1

in the next column. Then the draftsman's initials and the date appears as a matter of course.

When a sketch or print came in from an outside firm I would enter it up in the book giving it a drawing number and size if possible, and if not simply giving it a number. I would then enter up the firm's name in the "draftsman" column, and their drawing or sketch number, if it had any, in the column headed "Remarks."

This was a great aid in filing as after finding the number wanted it was an easy matter to locate the drawing provided it was in the drawer where it was filed. It was not necessary now, as formerly, to pull the drawer out and lift up all the drawings when searching for some small sheet sure to be away at the bottom and in the back of the drawer. Instead only the corners had to be raised until the correct number was located. That was a great improvement and I begun to have visions of setting at a roll top desk and branding as N. G. all the schemes brought up to me by a bunch of ambitious young draftsmen even as I had had my own schemes turned down when with a decent sized company.

I got shook out of that pipe dream, however, when the G. M. gave me to understand that a tracing of every drawing was both unnecessary and a waste of time. So in order to keep the drawings that were not traced, in decent shape, I shellaced each drawing before I let it go into the shop and got fairly good results. The dirt could be wiped off, and the only bother was to see that they were returned as soon as the shop did not need them any more.

Even with this scheme a drawing was lost once in a while so when an important drawing went into the shop without any tracing being made I would tack it up in as convenient a spot as possible and, as I had won over the foreman by means of candy given to his kids, the drawing stayed there until the job was done, and I took it down.

These little reforms worked so well that I determined to make a big improvement in the method of numbering the patterns. The method then in use was that of serial numbers no method being used to separate pieces composed of different metals. My scheme was such that the number would tell the material, no prefix being used for cast iron; but for composition an O appeared before the number. As several different metals were used when aluminum was reached the pattern number had about five O's before the actual number was reached, and the difficulty of getting all those figures on a small piece, and in such a manner that they might be easily seen was a job worthy of an expert geometrician. Needless to say the G. M. soon found the new system was of little use, and while I was busy getting the numbers taken out under the would-be new system, changed to suit the old system, he called me into his office, and kindly (?) explained that the shop where he worked when he was an apprentice, twenty years ago, used the method he was using for numbering the patterns when I appeared; also, that as the system had stood a twenty years' test it was all right, and I must strictly adhere to it. I began to think I had best stick to drafting and leave systematizing to the general manager and the machinists, and I did so for some time.

L. E. VATOR.

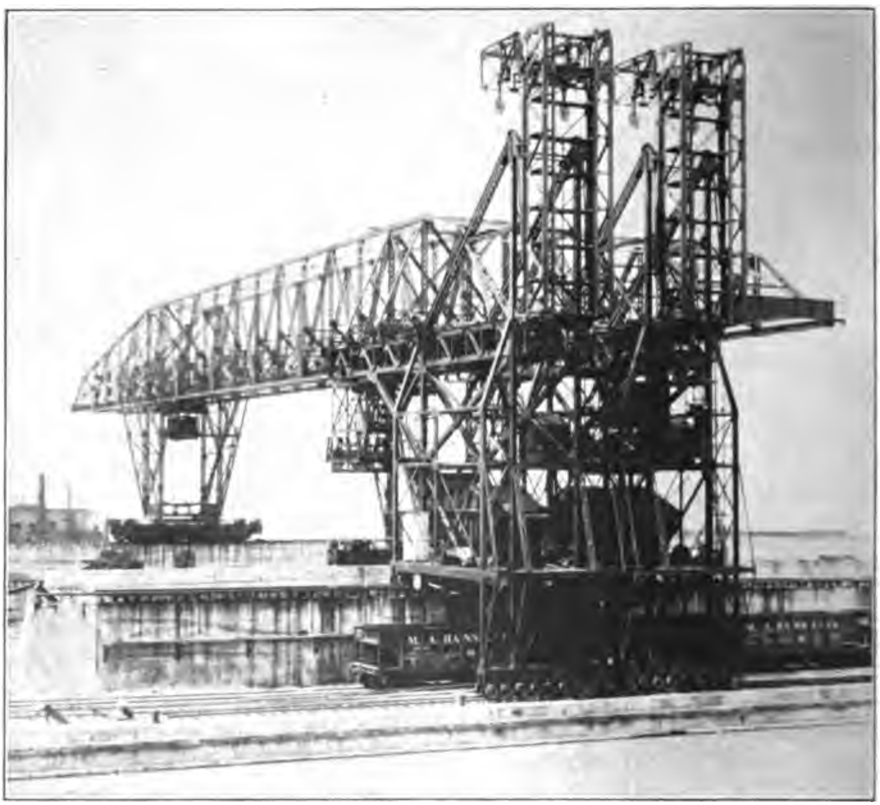
Piston Rings.

A German firm manufactures piston rings in the following manner: The rings are cast and turned out of circle so that after a part is cut out and the ends brought together the ring is a perfect circle. They claim great economical advantages, viz., saving of steam and uniform wear.

The article in October issue on "Draftsman Ink Stands" should be credited to Mr. J. G. Bayley, of Philadelphia.

the operator. The trolley which has a cage for the operator works at a height of 55 feet from the dock, and the man who rides in it is complete master of his own machine. He is able to readily twist the grab crosswise of the hatch at right angles, to the line of travel of the trolley, to rush the trolley from the boat to the cars or trough, to hoist the boom and to shift the machine along the dock. The motors will be of sufficient capacity to make round trips with maximum loads in 50 seconds from ore directly underneath the hatch of the vessel being unloaded. Theoretically, therefore, about 360 tons could be unloaded every hour. At this rate a 10,000-ton boat could be unloaded in five hours. However, it is not possible to make quite such good time as, after most of the load is out, time is lost in "skimming" the rest of it.

Most of the machines on the lakes of the clam-shell type, have the operators back at the end of the boom where it is hard for them to see

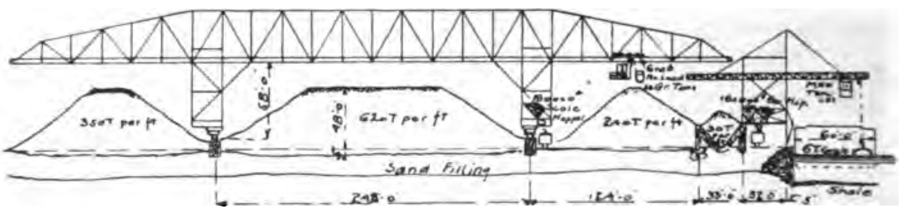


Unloader and Bridge, Hoover & Mason Fast Plant, Ashtabula Harbor, Ohio.

weight about four tons. Or generally speaking the cars are either over or underweight. They never are exact. To give an illustration of what a four-ton under weight means, an 85-cent freight can be taken on a daily shipment of 500 cars. On each car, the haulage loss will be about $3.50 and on 500 cars, just 500 times $3.50. The automatic weighers weigh a carload to within 500 pounds.

In loading cars without automatic scales of this kind, the overloaded cars must be switched to a separate track and "trimmed," while the underloaded cars must be hauled through. If the cars were all loaded to their capacity, they would be just as easy to haul as if they were not so it can be seen what a big economy the new arrangement will be. It will not only save labor, but it will keep the empties running along faster by saving time.

To load a car the rollers are actuated a sufficient length of time to discharge ore to the maximum capacity of the car, as indicated by the dial, at the same time enabling the cars to be loaded in train form without being disconnected. Mechanism for raising the boom and moving the machine along the dock will also be provided.



Outline Diagram of Unloader and Stock Pile.

The bridge, as has already been mentioned will be 550 feet long, and as shown in accompanying sketch will rest on turntables, which permits either end to travel independently in order to better cover the storage piles. In the tower next to the dock will be placed a scale hopper, similar to those on the unloaders, and resting upon scales of 180,000 capacity. The dial and method of operation will be the same as those on the unloaders. The grab on the ore bridge will be of the latest type, of 14 gross tons capacity, and the hoisting and traverse motors will be in the trolley and travel with the operator. Westinghouse air brakes will be used to control the traverse motion and air brakes and also air governors are provided to control the descent of the grab. Westinghouse friction draft gears are provided at the end of the bridge to prevent accident. The hoisting speed of the grab will be 140 feet per minute and the traversing speed of the trolley will be from 800 to 1,000

The boilers are Sterling water tubes of 200 horse power each and the furnaces are equipped with Roney stokers.

The boilers are fed by two Blake, outside packed, feed pumps 10 x 6 x 12 with a bank of valves so arranged that water can be distributed from any pump to any line desired. Each boiler has double feed lines and in addition, there is a washout and a water heater line. The valves are arranged so that if one pump should get out of order, they could be cut in on the other without causing any delay.

Economy is practiced by the use of the large 1,200-gallon water heater. The exhausts are run into this heater so that the water can be brought up to a high temperature and then, when it is fed into the boilers, the number of heat units necessary to bring it to a higher temperature is reduced. In this way, the fuel bill is reduced materially. By this arrangement the exhaust steam is nearly all condensed by the time it leaves the heater.

The water is supplied by a 21-foot well 12 feet wide and 18 feet long. It is four feet below the lowest level of the river and is connected with the river by means of a 24-inch suction pipe. From the well to the pumps is an 18-inch suction pipe. By this arrangement, the efficiency of the pumps is increased. The water from the condenser is discharged into a hot well 18 x 8 x 8 from which it is pumped by the boiler feed pumps, the excess passing through a 24-inch overflow to the river.

There are two Ballwood cross compound condensing engines of 650 H. P. each. The engines are each connected with a 400 K. W. Wood direct dynamo, with gravity oiling system.

In the engine room is a 30-ton hand crane equipped to traverse the entire engine room and built for the purpose of facilitating repair work. Besides this, the engine room contains a large booster or motor generator connected in series with the battery, and this is excited by separate motor driven machines. This automatically regulates the charge and discharge of the battery.

The gauge board and the switchboard are marble. The latter consists of ten marble panels, three of them for the dynamos, one is for totalizing the Watt meter with general bus bar instruments, two are for the battery equipment, two are for the boosters, one for the unloader circuit and one for the bridge circuit.

In the battery room there are 110 cells of the Gould type, each containing [illegible] plates, but each large enough for an extension of 18 additional plates. They are well insulated. The room is equipped with a brick floor covered with pitch and thoroughly drained to allow for

Pneumatic Conveying of Light Materials.

By Walter B. Snow.

THE practice of conveying materials by pneumatic means may be roughly classified under two methods.

First, that which requires the creation of a pressure difference upon either side of a fairly close-fitting body in a tube of uniform cross section The boy's bean-shooter embodies this principle in its simplest form.

Second, that in which the material is finely divided, and relatively light enough to be held in suspension by the moving air. In unconfined space, action of the wind upon the debris of the streets and fields is a familiar illustration.

Under both classifications a pressure difference between the ends of the conduit is necessary. In the former case the action is positive and direct. It may be definitely measured, except for frictional and leakage losses, as is the movement of a piston in a cylinder. The pressure created is usually relatively high, frequently requiring for its production either the positive type of blower, or the air compressor.

In the latter case the conditions and results are far more indeterminate. But the pressures are usually much lower, such as may be created by the fan blower in some of its types.

Under ordinary operating conditions the rate of air flow must fundamentally be brought up to a velocity which will keep the material in motion. A lower velocity may not only result in slower movement, but in absolute loss of ability to move the material at all.

The condition of the material itself is likewise an important factor in the success of the system. The open paper may be picked up and floated away by a mere zephyr; when compressed into a cylinder roll it becomes almost immovable. But if it be cut or broken into small particles, these, because of their greater superficial area relative to their weight, may readily respond to the effort to convey them by pneumatic means.

The economy of this method of handling material is necessarily relative. Great volumes of air and considerable expenditure of power may be required, but if by such means the material may be transported at less expense, or with greater convenience, the system may be accepted as superior.

A careful consideration of the functions of air in motion will lead to far greater efficiency in such installations. To the ordinary inexperienced individual, a slight change in the speed of a fan suggests only a similar proportional change in the pressure produced, and the power required. But while with a constant area of discharge or resistance the volume delivered by a fan is practically proportional to the number of revolutions, for other relations exist in connection with the pressure created and the power required.

The pressure produced by air in motion varies as the square of its velocity. That is to say doubling the velocity results in a four-fold increase in pressure. So far as it is the mere purpose of the fan to increase the pressure on the outlet side, or its counterpart, the vacuum, on the inlet side, this relation of velocity and pressure is conducive to a wide range of results with moderate variations in speed. But when the number of revolutions of a given fan is increased for the sole purpose of increasing the delivery, the result is disastrous to economy, as evidenced in the power required.

The power expenditure represented by air in motion is measured by the product of its velocity into the total pressure exerted against a given area, just as in the case of an engine piston, it is the distance moved through multiplied by the total pressure. When the area remains constant, as is usually the case with a fan when mere change in speed is made, the power varies simply as the product of the velocity and the pressure. But the pressure has already been shown to vary as the square of the velocity, hence the power must vary as the cube of the velocity. That is to say, the fan when run at double the speed, requires eight times the power. If the speed be increased three-fold, the power will mount up to 27 times that required at normal speed. Even an increase of only 25 per cent in speed, a change not at all unusual, practically doubles the demand for power. Or, to put it in another form, the power required by a fan may be reduced one-half by decreasing the speed only 20 per cent, which means a corresponding decrease of only 20 per cent in volume. Even a 10 per cent reduction in speed and volume saves over 25 per cent in power. The folly of driving a fan a single revolution above that absolutely necessary is thus made manifest.

With the ordinary type of fan, the maximum velocity of discharge of air through the outlet is obtained only when that outlet does not exceed a specific area dependent upon the dimensions of the wheel. The velocity thus obtained is practically equal to the speed of rotation of the circumference of the wheel. This velocity determines the pressure, and is the primary element in establishing the power expenditure.

Modern Coaling Stations and Cinder Pits.

A COMMITTEE of the Association of Railway Superintendents of Bridges and Buildings sent out a request to answer the following questions with reference to the construction of Coaling Stations and Cinder Pits:

COALING STATIONS.

1. How is coal handled? Whether from elevated trestle, dumping the coal from cars into pockets, shoveling from cars into pockets, link belt conveyor, or by locomotive crane from cars or storage pile.

2. Approximate cost of plant, giving some detail.

3. Capacity in tons per hour, and for each 24 hours.

4. Cost of coaling engines, per ton.

5. In your opinion, what is the best type for coaling stations having capacity of 50, 100, 300, 500, 1,000 and 5,000 tons, with reasons for same.

6. What kind of power do you prefer to operate the machinery of coaling stations? Whether steam engine, gasoline or electric motor.

CINDER PITS.

1. Description, whether depressed track for ash cars, link belt conveyor, swinging or traveling crane handling buckets.

2. Approximate cost of construction, giving some detail.

3. Greatest number of engines to be cleaned per hour, and average in each 12 and 24 hours.

4. Cost of handling cinders per yard.

5. If machinery is used, is it operated by same power that operates coaling plant?

6. In your opinion what is the best type of pit for handling ashes at stations where there are 5, 20, 50, 100 and 200 engines per day to be cared for?

Some of the answers are here given with a summary at the end of this article.

(A) J. P. Snow, Civil Engineer, West Somerville, Mass., Coaling Stations:

We have a modern coaling station at Ayer, Mass., which I will try to describe briefly.

The coaling plant at Ayer consists of a trestle 13 feet high, with two track hoppers built under it. These hoppers will each hold a carload. They discharge by a simple guillotin gate 2 feet square into a 1-ton tub, which is raised on a C. W. Hunt inclined boom to empty automatically into two elevated hoppers, 15 feet by 20 feet, holding each about 150 tons. These hoppers deliver to locomotives by four Williams and White chutes, with Anderson controllable gates. There is no provision for weighing coal, as our people do not think it pays to go into the complication necessary. This plant is worked with one hoisting engine, so that but one tub is in use at one time. Thirty tons per hour is easy work. The measure of speed is getting the coal out of the cars.

We have two fairly modern styles of ash-pits, one of which is an air-hoist hung from a gallows frame, which spans the pit track and an ash-car track alongside. The ashes are dumped from the engine into a bucket in the pit underneath, the engine moved away and the bucket raised by the air-hoist and traversed over the car, where it is dumped and returned to the pit ready for another engine. The other is a pit with depressed car-track alongside. The engine track is elevated as much as circumstances will allow.

(B) Charles Carr, Superintendent Buildings, M. C. R. R., Jackson, Mich.

COALING STATIONS.

1. We use all the methods mentioned except the last (locomotive crane from cars or storage pile).

2. Cost of plant (link-belt conveyor) $22,355.60, distributed as follows: Pit, $4,250.30; chute, $15,405.30; tracks, $2,700.

3. Five hundred tons per twenty-four hours, twenty-one tons per hour.

4. $0.0478 per ton.

5. Link-belt conveyor, for the reason of its being the most economical.

6. Electric motor when available; if not, a gasoline engine.

CINDER PITS.

1. Depressed track pit.

2. Cost of two pits, $5,277.84 (track work not included).

3. Average of eighty engines cleaned every twenty-four hours.

4. Could not say, as men who clean engines find time to handle inders also.

5. No power used.

6. Depressed track pit.

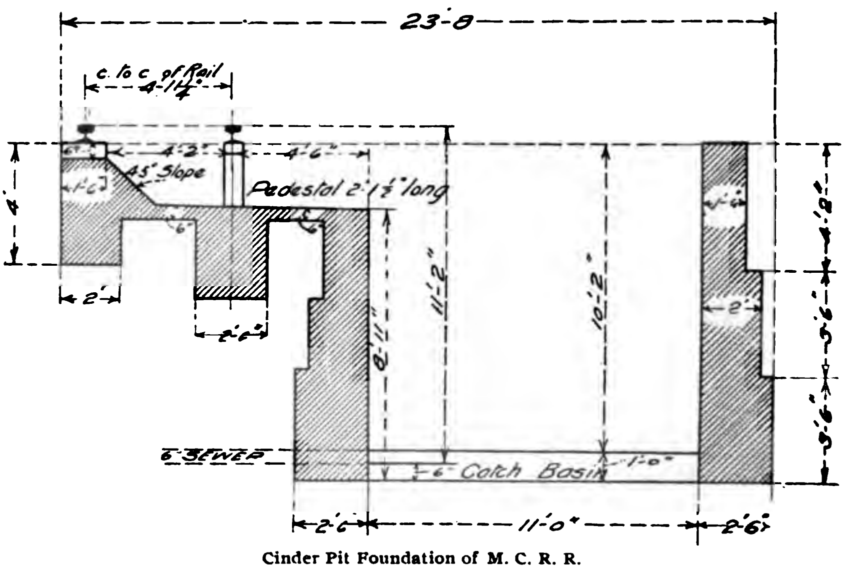
(C) Mr. E. Brown, Master of Bridges and Buildings, Grand Trunk Railway, Allendale, Ont.:

Our general practice here is to use some form of coal storage pocket with incline to haul cars up and dump the coal direct into the bins, or else a Fairbanks-Morse elevator, according to the lay of the land The cinder pits are of the common depressed type. The engines are cleaned into a kind of basket, which is subsequently lifted with a compressed air hoist, and dumped on to a flat car.

(D) Mr. J. N. Penwell, Supervisor of Bridges & Buildings, Lake Erie & Western Railroad Company, Tipton, Ind.:

COALING STATIONS.

1. We have three kinds of coaling stations. Five of them are elevated trestles, with the old-fashioned bins with automatic drop aprons. The coal is shoveled by hand from the cars into the bins. The engine men operate the bins from the outside. We have one coaling station with elevated trestle and dump carts, coal being shoveled by hand from the cars into the dump carts, and then operated by the coal heavers. Three coaling stations with old-fashioned derrick and buckets, using air for power, the air being taken from a locomotive. None of our coaling



Cinder Pit Foundation of M. C. R. R.

stations are modern in any way and the one where we use the small dump carts is the most economical.

2, 3. Will hardly be considered with our old coal docks.

4. Costs from nine to twelve cents per ton, an average of about 10 cents.

5. My limited experience with modern coal docks will hardly permit me to give an intelligent reply.

6. I would recommend motor power if a current can be secured at reasonable price, otherwise steam engine. Gasoline engines are too uncertain and the unsettled price of gasoline forbids me recommending gasoline engines.

CINDER PITS.

We have no modern cinder pits. We have a depressed track for our cinder cars. We use iron piling with I-beams for stringers, and cast-iron clamps to hold the rail, in most of our cinder pits. Others are built of fire clay with cast-iron coping to hold the rail.

Where fifty engines or less per day are to be cleaned, I would recommend a cheap cinder pit with depressed track for cinder cars, transferring the cinders by hand, as the enormous expense for maintenance of modern cinder pits would not be justified. Where from fifty to one hundred or more engines per day are to be cleaned a more modern pit would be required, but I can not give an intelligent opinion as to the particular kind, as we have none in use.

(E) Mr. H. H. Eggleston, Supervisor, Bridges and Buildings, Chicago & Alton Railway Company, Bloomington, Ill.:

1. Link belt conveyor.

2. Cost of plant, two bins complete, capacity of each bin 130 tons, about $12,000.

3. Capacity of coaling stations from fifty to sixty-five tons per hour.

4. Cost of coaling engines per ton, from one cent to two cents, according to the number of tons of coal elevated.

5. Link-belt conveyor for coaling stations having a capacity of 500 tons or over. For coaling stations under 500 tons of coal, I would think the elevated trestle would be the cheapest. The link-belt plant does not take up as much room as an elevated coal trestle and in some places this would be more economical where the space is limited.

6. Prefer electric power in coaling stations, as there is less danger from fire than a steam or gas engine power plant.

CINDER PITS.

1. Depressed track for ash cars. We also have a link-belt conveyor from depressed pits. Traveling crane handles buckets on depressed track very cheaply and satisfactorily.

2. Approximate cost of construction of two pits and conveyors each 150 feet long, opposite each other, about $5,000.

3. Cinder pits, average number of engines in twenty-four hours, about fifty.

4. Cannot say exactly, as the men handling cinders do other work at coaling stations and I have no figures.

5. Same machinery used to operate link-belt cinder pits as is used to elevate coal. On depressed bins and conveyors, the same machinery is not used to elevate coal and cinders.

6. I think that depressed pits and conveyors would handle more cinders than a link-belt pit of the same capacity, as more engines can have their fires cleaned at the same time.

(F) Mr. M. R. Strong, Engineer of Bridges and Buildings, Erie Railroad:

1. Coal is unloaded from drop bottom cars into a concrete pit; track over this pit being elevated four feet above the ground and carried on I-beams supported on concrete piers.

2. Plant consists of locomotive crane costing $6,000; concrete pit costing $1,300.

3. Forty tons per hour can be handled from one of these pits.

4. Cost of coaling engines per ton, between two and two and two-tenths cents; this price includes picking up cinders

5. For terminal stations the best type of a coaling station is that described above. For points where trains take coal while in transit, elevated pockets from which the coal is conveyed to the hopper by link-belt or rubber belt conveyors.

6. Electric power is preferable for operating machinery at coaling stations when same is available for continuous hard service; where electricity is not available, steam engine. Where coaling station is operated intermittently, gasoline engine.

(G) Coaling Station at Buffalo, N. Y.:

1. Coal is dumped from cars to storage pit and delivered on engines by locomotive crane.

2. One half cost of locomotive crane, $4,250; cost of coal pit, $6,000; total, $10,250.

3. Crane not worked to full capacity. Handles about twenty tons per hour, or an average of 400 tons each twenty-four hours.

4. Cost per ton, coaling engines, $0.046.

6. Gasoline or electricity, which ever is most economical.

CINDER PIT AT BUFFALO, N. Y.

1. Ashes are dumped into a pit 8 feet wide and 9 feet deep from locomotives. They are then loaded into cars by means of locomotive crane.

2. One half cost of locomotive crane, $4,250; cost of pit, $5,000; total, $9,250.

3. Greatest number of engines per hour, five; average twelve hours, forty; average twenty-four hours, eighty.

4. Cost of loading cinders, $0.018 per yard.

5. Yes. Locomotive crane handles both the coal and cinders.

6. Concrete cinder pit with double I-beam stringers under one rail line resting on cast-iron pedestals at twelve-foot centers. Cinders to be loaded by locomotive crane.

(H) Coaling Station at Port Jervis, N. Y.:

1. Robins' Conveying Belt Co., coal emptied into track hopper and elevated to coal pockets by belt inclined forty-five degrees.

2. Foundation and piping, $2,485.42; timber and steel structure, including hoppers, etc., $20,728.91; chutes, belts, electrical appliance motors, etc., $3,055.57; total, $26,269.90.

3. Tons per hour eighty. Each twenty-four hours, 1,400 tons.

4. Cost of coaling engines, $0.0225.

CINDER PITS.

1. Depressed pit in which cinders fall directly in the water and are removed and loaded into cars by locomotive crane.

2. Concrete pit, 90 feet long, $2,000 cost; I-beam girders, $360 cost; sewer draining pit about $300. The same crane handling coal handles cinders.

3. Three engines can be cleaned at once, making average time of cleaning fifteen minutes.

4. At a point where fifty engines per day are handled, cost of unloading cinders is included in the cost of two and one-half cents per ton for handling coal, as crane can handle in thirty minutes cinders from twenty-five engines.

5. Same style power should operate cinder plant that operates coaling plant.

6. A good type of pit for from fifty to seventy-five engines per day is shown on attached print.

(I) Cinder Pit at Salamanca, N. Y.:

1. Cinder pit is of concrete construction, about 300 feet in length, and operated by locomotive crane.

2. Approximate cost of construction, $10,500, including track supports and sewer.

3. Engines cleaned per hour, five. For an average of twelve and twenty-four hours, twenty-five and forty-six, respectively.

4. Cost to handle cinders per yard, $0.03.

5. Locomotive crane.

(J) Cinder Pit at Susquehanna, Pa.:

1. Concrete cinder pit, 8 feet, 6 inches wide, 11 feet deep and 320 feet long.

2. Cost of pit, including locomotive crane, $18,000.

3. It is possible to clean twelve engines per hour. Greatest number engines cleaned in twelve hours forty-one, greatest number cleaned in twenty-four hours eighty.

4. The total cost of hauling cinders from pit to cars is $0.007.

5. Locomotive crane handles cinders only at this point.

(K) By M. Bishop, Master Carpenter, C., R. I. & P. Railway, Chickasha, I. T.:

1. On the Oklahoma Division of the Chicago, Rock Island & Pacific Railway, we have the Williams-White, pocket coal chute, elevated trestle. Shovel by hand from cars to pocket.

2. The cost of a fifteen-pocket coal chute runs from $3,500 to $3,800.

3. This style and size of chute will afford from eight to ten tons per hour.

4. Cost of coaling engines by contract is nine and one-half cents per ton. This includes the cleaning up around coal chute and loading cinders.

5. In my opinion, the best type of a coaling plant for all capacities, more especially a one-hundred ton or greater, should be a large bin, elevated trestle, with a spout or an apron outlet, with a positive gate so that the coal can be trimmed on the tender to the amount required, dispensing with any waste or droppings of coal on the ground. The height of these storage pockets should be so that hopper bottom cars could be used. And an incline built, where possible, so that the coal cars could be placed by locomotives instead of hoisting machinery. My reason for

Something on this order, I believe, would be profitable where they handle fifty or more engines.

(L) By Mr. W. B. McKenzie, Chief Engineer, Intercolonial Railway, Moncton, N. B.:

According to information given me by the mechanical department, I find that the cost of handling coal and ashes at the following places is as below:

Moncton, by the Hunt Elevator System, handling coal, per ton, thirteen and two-thirds cents, thirty tons per hour; capacity of bin, 500 tons. Cost of handling ashes per cubic yard, five and two-thirds cents, if this plant had work to run to its full capacity.

Stellarton, dumping from trestle onto an elevated floor and running into engines by small dump cars. Cost, twenty-one cents per ton for coal, and ten cents per cubic yard for removing ashes by hand. Capacity of plant, 100 tons every twenty-four hours.

Point Tupper, shovelling coal from cars into small trolley cars and dumping into engines, twenty-one cents per ton. Removing ashes by shovelling from ash-pit onto flat cars, eleven cents per cubic yard.

(M) By Mr. D. McLennan, Mechanical Foreman, Intercolonial Railway, Sydney, N. S.:

In reply to yours under date of the first inst., I think the best we could do with the coaling shed we have here would be 100 tons each twenty-four hours, or about four and one-half tons per hour, with three men by day and the same number by night. When working to this capacity, it would cost about eleven and three-fourths cents per ton to coal the engines. We handle the cinders here by hand, first shoveling them from the ash-pit onto a platform, and then from the platform onto flat cars, and to handle in this way cinders produced by 100 tons of coal consumed, would cost about twelve cents per cubic yard.

(N) By Moses Burpee, Chief Engineer, Bangor and Aroostook Railroad, Houltin, Me.:

HANDLING COAL.

1. Shoveled from cars standing on trestle in shed, then delivered to locomotives in tubs raised by cranes, usually operated by hand, but in a few cases by power. In some cases also dumped into pockets or chutes through which it is delivered to locomotives. In other cases, shoveled from cars into sheds having an overhead I-beam with trolley, to which tubs, loaded by hand, are raised by differential pulley, or, as in our case,

by air hoist. These are switched onto a cross track running out over the tender, dumped and returned to main trolley rail and lowered to coal pile.

2. Sheds cost about $1 per ton capacity. Fixtures and machinery, about $1,000 per shed.

3. Capacity is limited to the amount of labor, in our experience

4. No figures.

5. Depends on circumstances. Think elevator and chute style best where possible to use it. We have heretofore been obliged to stock up for six months every spring and fall, in which case large sheds or stocks are necessary, and a good deal of hand shoveling requisite.

6. Compressed air where possible. Electric or gasoline.

CINDER PITS.

Cannot give from experience any opinion as to improved pits. We have not used power to handle ashes.

(*O.*) *By C. F. Loweth, Engineer and Superintendent, Bridges and Buildings, Chicago, Milwaukee & St. Paul Railway Company, Chicago:*

It is only comparatively recently that this company has introduced the use of mechanical coaling plants and cinder pits on its lines, and to date, have had experience with only two types of such coaling stations, namely, the car haul system and the link-belt and bucket elevator system, typical plans of which I am sending you under sesparate cover.

The former consists of one or more elevated storage pockets of any desired capacity, set on beam scales for the purpose of weighing the coal out to the locomotives, with an incline track on which the loaded cars are hauled up over the storage pocket and dumped on breaker bars on which the coal is broken to the proper size before it falls into the storage pocket.

The cars are hauled up preparatory to unloading by means of hoisting machinery of the friction drum and gear type, driven either by steam, gasoline or electric power, and unloaded. The car is then let down the incline by means of the same hoisting machinery and the process is repeated.

The handling of coal through a coaling plant of this type is fairly economical, when only hopper bottom cars are used and the coal is in comparatively small lumps. Coal in large blocks or lumps requires much breaking with hammers, over the breaker bars. This process is slow and the cost of handling proportionately higher.

The cost of handling coal through a plant of this type may vary from three and one-half to eight cents a ton, owing to varying conditions. The cost of this type of plant may vary according to size and capacity, from $8,000 for the smallest, with a storage capacity of 100 tons, to $20,000 with a storage capacity of say 5,000 tons, and the handling capacity may vary from twenty to fifty tons per hour, according to conditions.

As to the link-belt and bucket elevator type of station: They consist of one or more track hoppers into which coal is dumped and from which it is conveyed to a crusher by means of a horizontal conveyor or carrier, thence to the elevator which conveys it into storage pockets, the pockets being set on scales for the purpose of weighing out coal to the engines.

This type of coaling plant has one distinctive advantage over the other above described in point of economy in the handling of coal, in that the coal is crushed mechanically, also in the more rapid process in getting the cars placed for unloading; but the cost of maintenance is considerably in excess of the other type, in that it contains much more machinery subject to wear and tear.

The capacity of these plants may vary from twenty-five tons per hour, with a storage capacity of seventy-five to 100 tons for the smallest, to 100 tons per hour with a storage capacity of 500 tons or more for the largest, and may cost from $9,000 to $30,000.

The cost of handling coal through this type of station under favorable conditions, that is, with exclusive hopper bottom cars and coal in condition to run freely, should not exceed two and one-half to four cents a ton. Under less favorable conditions, it may cost as high as eight cents.

I will add that I am not prepared to express an opinion as to the best type of coaling station in use. Electrical power is undoubtedly the best for driving coaling plant machinery, although steam or gasoline power may be successfully and economically applied.

As to cinder pits: This company uses the open shoveling pit with adjoining depressed track, the cinders being shoveled by hand, also the mechanical pit, consisting of a number of pans or cars, in which the cinders are raked out of the locomotive ash pans and elevated on an incline track and dumped in cars on an adjoining track by means of a pneumatic hoist.

The cost of construction of the above described pits is about the same, and the cost of handling cinders through them does not vary materially.

use of filling purposes on the division. You will note by the blueprint that these cinders are handled by compressed air and I wish to state that we get very good satisfaction from our style of cinder pits and hoists.

Cost of Thompson coal wharf, located at Thompson Yard, on Monongahela Division of Pennsylvania Railroad:

Material.		
Sand, gravel and cement	$ 2,976.52	
Iron sheeting for use of lining coal bins	861.00	
Rails, bolts, nuts, washers and fixtures	2,291.34	
Lumber	10,587.90	
Eight coal chutes and installing same	2,210.00	
Sand elevators and installing same	219.50	
		$19,146.26
Labor.		
Masons on foundation	$ 2,710.00	
Carpenters, erecting	2,723.41	
Tinners and plumbers	184.53	
		$5,617.94
Total		$24,764.20

Cost of Thompson ash pit and hoist on the Monongahela Division of the Pennsylvania Railroad:

Material.		
Brick, sand, gravel and cement	$2,254.12	
Rails, spikes, etc.	180.00	
Pneumatic ash hoist and three buckets	947.72	
		$3,381.84
Labor.		
Masons' and carpenters' labor		1,433.29
Total		$4,815.13

Cost of handling coat at Thompson coaling station:

1906	January	$0.018
	February	.02
	March	.019
	April	.02

Number of tons of coal handled at Thompson coaling station::

1906	January	4,786
	February	5,304

March	5,933
April	5,617

Greatest number of engines cleaned per hour, and average in each twelve and twenty-four hours at Thompson cinder pits::

		Per hour.	Av. 12 hrs.	Av. 24 hrs.
1906	January	2	2	50
	February	4	4	99
	March	2	2	50
	April	2	2	47

Cost of coal for operating ash hoist at Thompson cinder pit:

1906	January	$83.22
	February	75.74
	March	76.39
	April	65.78

(Q) By Arthur Montzheimer, Chief Engineer, L., J. & E. Ry., Joliet, Ill.:

COALING STATIONS.

1. Our coal is handled from an elevated coal chute. The coal is dumped in the chute by gravity in bins holding 100 tons. From these bins the coal is allowed to pass by gravity into the smaller pockets same as the Williams & White coal chute. Cars of coal are pulled up the chute by means of gasoline engine and cable.

2. The approximate cost of this plant is $9,000.

3. It has a capacity of eleven tons per hour or 264 tons per twenty-four hours.

4. Cost of coaling engines is from one to two cents per ton.

5. This is the best type of coaling station I have had any experience with. I think it will handle business at almost any terminal point.

6. We prefer gasoline engine to hoist coal with, although at one place we are hoisting coal with a steam engine.

CINDER PITS.

1. We use depressed track for cinder cars, the cinders being loaded by hand. An illustration showed the style of casting or cinder pit ties used for supporting the track carrying the engines across the pit

2. I cannot give you any figures on the cost of this type of construction, as it varies according to the location, depth track is depressed, etc.

3. A pit of this kind, 100 feet long, can handle eight or ten engines per hour.

4. Cost of handling cinders amounts to eleven cents per cubic yard.

5. No machinery is used in connection with this cinder pit.

6. I think this is a very good type of cinder pit for the ordinary terminal, but for a large terminal I would recommend a pit where the cinders are hoisted by power and dumped in a bin from which they can be dumped by gravity into the cinder car.

(R) By J. B. Brown, Kansas City, Clinton & Springfield Railway, Clinton, Mo.:

COALING STATIONS.

1. We have on our system five or six different styles of coal chutes, but I will take our standard at Springfield for answers.

Coal is handled by link-belt conveyors and elevated trestles.

2. Approximate cost, $20,000.

3. Do not know the capacity in tons per hour.

4. Cost of coaling engines, two to five cents per ton.

5. My opinion is the link-belt conveyor is the best type of coaling plant, because is requires less room for capacity in tons than any other.

6. Prefer steam engine for power, as they can always be depended upon to do the work.

CINDER PITS.

1. Our cinder pits are depressed track for ash cars and link-belt conveyors.

2. These pits are in connection with our coal chutes; combined cost, $20,000.

3. Do not know number of engines coaled per hour.

4. Cost of handling cinders, from four to eight cents per yard.

5. The machinery is operated by same power as coaling plant.

6. Link-belt conveyor and depressed track for ash cars.

HANDLING COAL.

1. Coal has been handled from elevated trestle, dumping coal from cars into pockets, and also at some of the stations by shoveling coal from cars into the pockets and at others by link-belt conveyor, and temporarily we have used crane for coaling from cars or storage pile.

2. You will find approximate cost of plant on drawings attached.

3. Capacity in tons per hour also to be shown practically on the blueprints.

4. I am unable to reply to this question. I have requested this information from the division superintendent, but, up to date, have had no reply. The cost of carrying for elevated trestle where coal is dumped

into pockets from cars, was, for twenty-five and thirty engines per day, not over $30 per month.

5. The best type of coaling stations where there is plenty of room for inclines, is the elevated trestle, where coal is dumped from the cars into the pockets. Whenever one is cramped for room, a link-belt conveyor is practical, on account of the ease of handling coal directly from the cars to the bins.

6. In operating machinery for coaling stations, I prefer either steam engine or electric motor.

CINDER PITS.

1. Am attaching blueprint showing depressed track for ash cars. Have never used link-belt conveyor or swinging or traveling crane handling buckets in caring for ashes from the ash pit.

2. Approximate cost of construction is shown in detail on blueprints.

3. With the cinder pits as shown on blue print, we clean three or four engines per hour, or at an average of seventy-two in twenty-four hours.

4. Regarding cost of handling cinders per yard, I have not been able to get this information from the division superintendent up to date.

5. No machinery has been used on my division for operating cinder pit.

6. The best type of pit is cast-iron pit.

I am attaching herewith estimate of the cost of installing one of these pits.

In one of our files, cost of installation of cinder pit, at Albuquerque, was $931.33, itemized as follows:

Labor.		
Quarrying rock and excavation	$147.25	
56 cubic yards concrete masonry	168.00	
21 cubic yards rubble masonry	52.50	
		$367.75
Material.		
Lime and cement	$166.00	
Metal	397.58	
		$563.58
Total		$931.33

Summary of Costs, &c.—Coaling Stations.

Letter	Style.	Cost of Plant	Cost per Ton.	Tons per Hour	Type Machine Preferred	Power.
A	Pit			30		
B	"	$22,355.60	$0.0478	21	Link B. Con.	Elec. or Gas Engine.
C	"					
D			.10			Electricity.
E	Pit	12,000.00	.01 to .02	50 to 65	Link Belt.	Elec. or Gas
F	Crane	7,300.00	.022	40		
G	"	10,250.00	.046	20		Gas or Elec.
H	Pit	26,260.00	.0225	80		
I	Crane					
J						
K	Pit	3,800.00	.095*	10		
L (3 stations)	"		.136 .21 .21	30		
M	"	$1000 per shed.	.1175	4½		
N	"	$1.00 per ton capacity.				Air, Gas or Electricity.
O	"	$8000 to $20,000	2½ to 4c.		Link Belt.	Electricity.
P	"	24,764.20				
Q	"	9,000.00	1 to 2c.	11		Gas or Steam
R	"	20,000.00	2 to 5c.		Link Belt.	

* Includes loading cinders and cleaning up around chutes.

Summary of Costs—Cinder Pits.

Letter.	Style.	Engines cleaned per hour.	Total Cost.	Cost per Yard.	Power Used.	Type Preferred or Suggested.
A	Bucket				Air	
B	Depressed track	3.3	$5277.84		None	Same.
C	Depressed type with basket				Air	
D	Depressed type					
E	" "	2	5000.00			Pits and Conveyor.
F						
G	Loc. Crane from pits	5	9250.00	.018		Loc. Crane.
H						
I	Loc. Crane	5	10500.00	.03		Loc. Crane.
J	"	12	18000.00	.007		"
K	Pits with cars	2	10 to 15 per foot			Dump Cars.
L	Three plants			.026 .10 & .11	Hand	
M				.12	"	
N						
O						
P	Bucket	2½	4815.13			
Q		8 to 10		.11	Hand	Hoist to Bins.
R	Depressed track			4 to 8c.		Link Belt & Depressed track.

The Quebec Bridge Disaster.

SINCE the collapse of the Quebec bridge on August 29, 1907, by which an immense, though incomplete, structure and the lives of many workmen went to destruction, the comment on the reasons for the failure have been many.

The coroner's jury developed the fact that the chief engineer of the bridge company had received a report that one of the chords had buckled and that he in turn, or through his assistant, had communicated with Mr. Cooper, the consulting engineer in New York.

It also developed that the orders to "get off the bridge and stay off," were given, yet it does not appear where the blame for failure to obey these orders can be placed, if really issued. Hence, some one between the consulting engineer's office and the men played false.

It was reported that the engineer did not consider the deflections serious enough to cause accident to the bridge, but of sufficient importance to send an assistant to New York to see Mr. Cooper.

The pieces of this particular chord had been in place for over a year and all the time more weight was being added to it, and if the reader will study the first illustration he will readily see the conditions under which many parts of this structure were placed.

A few notes from the *Scientific American* give some idea of the enormous stresses that were placed on the compression members.

"The general public has but a faint idea of the enormous stresses to which the members of a cantilever of the size of the Quebec bridge are subjected. The chord member which failed was *supposed* to have a safe strength of 9,312 tons; that is to say, it could be subjected to an end pressure of this enormous amount without any signs whatever of deflection or buckling. In order to illustrate just what this means, our artist prepared a drawing showing this member, 57 feet in length and measuring 5 feet 7 inches by 4 feet 6 inches in section, stood on end on a suitable pedestal, and carrying the United States armored cruiser 'Brooklyn,' whose weight is 9,215 tons. Now, according to the calculations of the engineers, this member should not only be capable of carrying the load of the 'Brooklyn' without failure, but it should be possible to add as an additional load, say, the cruiser 'Marblehead,' of 2,100 tons weight, before the column would begin to show signs of distress, the total load

or the point at which the steel would begin to yield without recovery. of over 11,000 tons representing close to the elastic limit of the material, Now, 11,320 tons represents the maximum possible load which it was estimated could come upon this member, due to the weight of the bridge itself, plus the weight of the live load, that is trains, vehicles, foot passengers, etc., plus the load due to a heavy wind storm. And, right here, we cannot but express our surprise that this member should have been made so light that, in the event of the maximum live load and the maximum wind pressure occurring at the same moment, the metal would be strained almost to the elastic limit. This is cutting matters down to a fine point with a vengeance. We understand that those who are responsible for the design claim that the probability of the conjunction of a maximum live load and a maximum wind storm was considered to be so remote as to be negligible in the computations. They considered, furthermore, that this contingency was preventable, since it would be possible in the event of a heavy windstorm to prevent more than a limited amount of traffic on the bridge. This was certainly a most astounding presumption; for it is always possible that a fully-loaded bridge may without warning be subjected to a gale of wind or even a tornado.

"However, as a matter of fact, this compression member failed under a load of about 8,000 tons, or less, this being the calculated load which was upon the bottom chord at this point, when the bridge went down. How comes it then, that failure should have taken place when the chord was strained to only about two-thirds of its calculated strength? An examination of the drawing of this member, as here given, and of the direction in which it yielded, affords conclusive evidence that it gave way because of the latticing which is supposed to hold its parts in true line was utterly inadequate to do so.

The Cantilever and Span that failed.

unbraced web plates buckled like the walking cane above referred to, and twisted into the S form in which they now lie beneath the pile of wreckage.

"It is our belief that not only was the lattice reinforcement absurdly light for the work it had to do; but that the outside dimensions of this member, which measured only 4½ feet by 5½ feet, were altogether too slight for the chords of a bridge of this enormous size. This criticism is borne out by a comparison with the sections, shown in our engraving, of the bottom chords of two other notable bridges, one the 1,000-foot, steel, arch bridge about to be built at Hell Gate across the East river, and the other the celebrated Forth bridge, whose cantilevers have a span a little less than that of the Quebec bridge. In the case of the Hell Gate bridge the bottom chord measures 7 feet by 8 feet 6 inches; and, although the total combined dead, live, temperature, and wind loads have a total of only 8,420 tons, the total area of metal at any point of section is 811 square inches, as against 735 square inches in the Quebec bridge, whose total load, as we have seen, is estimated at 11,320 tons. Moreover, the metal of the Hell Gate chords is distributed around the circumference, instead of across the whole member; and in place of light angle latticing it is stiffened throughout with solid cover plates, and has three one-half inch diaphragms, with stiffening angles, extending across it at three

The Ruin as it Appears from the Shore.

points of its length. The Forth bridge bottom chord is an even stiffer construction than this. It consists of a tube 12 feet in diameter, built up of ten 12-inch longitudinal I-beams, riveted to an outer shell 1¼ inches in thickness, with circular stiffening webs worked in at 8-foot intervals throughout the whole length of the tube."

The disaster may even raise a question as to the limit to which the cantilever principle may be safely applied. The cantilever came into favor about thirty years ago. Since then many bridges of this kind have been built, notable among which is the one at Niagara Falls. This form of bridge is used in Europe about as much as on this side of the Atlantic.

The failure of this structure gives a hard blow to the industrial progress of northeastern Canada.

Consul J. H. Worman, reporting from Three Rivers, says that one of the most serious results due to the Quebec bridge disaster will be the delay caused in the completion of several railway connections badly needed for the opening up of the Lake St. John region, and the territory to the north of it. He adds:

"Various industrial enterprises projected in this belt, enriched by vast forests yet untouched and streams affording water power of priceless value, will have to be deferred for a year or more, as transportation facilities are wanting. The American concern in charge of the construction states that it will take two years to regain the condition that existed before the accident. It is reported that the Dominion government will herself undertake the completion of the bridge as soon as the investigation into the causes of the disaster has been completed."

Forward!

This is no time for the pessimist. The man who can see nothing but the dark side at the present moment is an enemy to the people. It is a time for courage and optimism; a time in which men of strong character, without undertaking to minimize the hardships or discouragements of the moment, take on new courage and become leaders in the restoration of confidence and the re-establishment thoughout the land of business activity.

The country was suffering to some extent from cramp colic, but in the natural order of things this would have passed away. The learned surgeons diagnosed it as appendicitis, and have been operating rather heroically, if disastrously to the patient. In the language of surgery they can say that "it was a beautiful operation," but the common sense of the American people knows that it was not a successful one. The recovery of the patient will not be due to the skill of the surgeons who made the false diagnosis and operated for the disease which did not exist, but the recovery will be due to the magnificent physical condition which will enable the country to sustain the shock and soon regain its wonted strength.

Every dollar lost to the Southern cotton grower or the Western wheat producer by the decline forced upon the country through the present financial situation, every dollar lost through the depreciation in securities through the wiping out of values, every laborer out of employment is a tribute to the power for evil of the demagogic agitation from press and pulpit and public men during the last 10 years.

As the farmer sees his cotton or his wheat decline in price through the inability of the banks to give him the needed financial assistance, as workmen here and there are already looking for jobs, while for the last five or ten years the jobs have been looking for the men, there will be brought home to them with intense force that the agitators throughout the land who have been fighting railroads and corporations, instead of proving a blessing, have proven a great curse. Every public man who has taken part in this active agitation, who has stirred up hatred against railroads, who has undertaken to cure imaginary appendicitis by the knife when the colic might have been cured by less drastic means, is responsible to the extent of his influence for the conditions which we now face. Sanity, the avoidance of hysterics, supreme confidence in his fellow-man and in his country and its unequaled resources are the qualities needed at the moment.—*Manufacturer's Record.*

Tariff on Wood.

If there be one tariff more destructive than another it is the tariff on wood. Other tariffs thrust pilfering fingers into the pockets of the common people, causing them to work the harder all their lives, that the protected interests may revel in luxurious laziness; but the tariff on wood not only robs the people in this way, but is far more devastating in its effect, threatening future generations and menacing the comforts and fertility of the country itself.

This tariff makes lumber dear; it makes building ruinously costly, and, as an exchange puts it, "It makes paper of every kind needless high in cost; it keeps out the Canadian wood and encourages the wholesale destruction of our own forests; and it menaces our waterpower, our water supply, our irrigation and threatens us ultimately with a landscape as bare and barren as that of modern Greece!"

Industrially, then, this tariff is an outrage.

home government western Canada appeared to be a likely field for the disposition of these superfluous and unwanted human beings, and the tide of immigration started. Great Britain has no desire to check the flood.

So great has been the influx of Hindoos into British Columbia that they have naturally drifted across the international boundary into Washington. Mill owners have been pleased to accept the services of these laborers at starvation wages. The pay of white workmen grew steadily smaller, and the dissatisfied were replaced by the men from India. It is but natural that those who have been deprived of their livelihood should feel deep resentment. Instead of wreaking vengeance on the mill owners, they have adopted the practical expedient of driving out the foreigners. The Indians, who are notorious for their cowardice, will probably not soon return to Bellingham.

Meanwhile it is not impossible that Great Britain will make the Bellingham affair a topic of diplomatic discussion. The English do not relish the idea of having their subjects, black or white, mobbed in foreign countries. Inasmuch as racial pride is not touched the Bellingham rioting will not assume the importance of the San Francisco Japanese outrage. But the Hindoo question is one which will soon be of great importance, and which must be definitely settled. The Indians are very much more dangerous to the welfare of the Pacific coast than the Chinese or Japanese. If the course of immigration is once diverted from Vancouver there is no reason to doubt that these brown Asiatics will pour into California and Oregon by the thousands. It is wise to consider, and if possible, to heal the disease in its earliest stages.

Pacific Coast Letter.

BY J. M. BALTIMORE.

A HEAVY and expensive piece of work is now in progress at San Luis Obispo, Cal.—the construction of the Avila wharf. This wharf is being constructed for general commercial and navigation purposes, the present dock facilities there being inadequate. The total length of the Avila wharf will be, when completed, about 2,500 feet, and over 40 feet wide. It will be supported by fir piles, each pile being protected by a thick coating of coal tar. The improvement is being made by the Avila Wharf Company of San Luis Obispo, at the outlay of a large sum. The work will not be completed for several months. It is being done by the Atlantic, Gulf & Pacific Company of San Francisco. The photograph shows the work now in progress. The wharf will be extended out until deep-sea-vessel water shall have been reached.

J B Haggin, a multi-millionaire, who, for many years lived in San Francisco, but now a resident of New York, and A. W. McCune, a capitalist of Salt Lake, have just secured from the Peruvian Government a big concession for the construction of what will be, from an engineering point of view, one of the most remarkable railways in either of the Americas.

These men have been granted a charter by the Chamber of Deputies for the construction of a railroad from Huacho, on the coast, to Cerro de Pasco, in the interior, where it will connect with water transportation. The railroad will be a link that will connect the commerce of the two coasts of South America.

The new road will span the dizzy heights of the Andes, an engineering feat long regarded as impossible. It will be the most expensive piece of road work ever contracted for by any railroad company on any continent. Three hundred thousand dollars a mile is the estimated cost. Within the distance covered by the road there will be 75 tunnels of varying length—driven through the mountains; 50 bridges will span the gaps between the mountain peaks, and more than 100 switchbacks will be utilized to get the trains across the greatest chain of mountains of all South America.

One of the tunnels will be driven through the mountains at an elevation of 17,000 feet, the highest point on the Continent. This road will be constructed for the purpose of securing an immediate outlet for the Cerro de Pasco mine, owned by the men to whom the concession was granted by the Peruvian Government. This mine has an output of millions every month, and is said to be the highest-grade copper mine in the world.

The longest and most expensive air tramway line on the Pacific Coast has just been completed in Northern California, extending from the Balakalala Mine to a point near Redding—to the big smelter at Coram. The trial of the tramway proved very successful in every respect. From the mine down to the smelter is 10 miles. On the trial trip, A. H. Brown, the superintendent of the mine, made the voyage in one of the hanging cars. He traversed the entire distance of 10 miles through the air in one hour and five minutes. The steel cable over which the ore cars will run is stretched over 64 iron towers. These towers range from 40 to 90 feet high. The longest span is 1,200 feet. The construction

of this immense cable tram cost a large sum, but it obviates the necessity of a railway, and passes over a very rugged stretch of country. The cable tram can easily handle the large output of the mines.

At a total cost approximating $100,000, the city of Oakland, Cal., is having constructed an immense concrete sewer. It is the largest and most expensive sewage conduit ever yet built in that city. This known as the "Main Lake Sewer," and its total length is 5,093 feet —nearly one mile. The style of construction is known as the "Horseshoe Section," the general contour being shaped like a horseshoe.

Throughout, the huge conduit is of reinforced concrete, and of uniform size. The interior dimensions are 6 feet wide, and 6.2 feet high at the crown. On the exterior walls the sewer is 9 feet wide at the bottom. The moulding is done in wooden forms—a section at a time—the huge molds being constantly moved forward as the work progresses.

For 1,800 feet the sewer crosses a stretch of tide lands—between the Southern Pacific's main line tracks and the United States Bulkhead line in the Bay. At all state of the tides this is under water, ten feet or more. For the other part of the distance the sewer passes through salt marshes, where some heavy excavation is necessary.

Active work was commenced nearly one year ago, and the contract has been about half completed. The big task will not be finished before mid-summer. The entire work is being done by the Atlantic, Gulf and Pacific Company, and the contracting firm is doing very satisfactory work.

All the sewer will rest on a foundation of piles driven down many feet and sawed off below the water level. Several thousand piles will be required for the foundation work alone. The portion completed only includes the distance across the salt marshes. The part yet to be built is the tide lands—practically under-water work. In building this entire sewer more than 4,200 cubic yards of concrete will be required.

Only that section of the sewer passing through the tide lands is specially reinforced; the reinforcement is No. 4 expanded metal. The upper part of the sewer follows the exact course of a large old wooden sewer. This latter is being torn out, and the new sewer entirely substituted.

The work is being crowded forward as rapidly as possible, though a large force can not be employed to advantage. The upper

Showing a long stretch of the sewer already completed.

Chattanooga Letter.

BY Z. ARMSTRONG.

Industrial activity in Chattanooga and vicinity is marked. Millions of dollars are being spent in private and public improvements, county and city buildings.

The brick walls of the new million dollar Southern passenger station are now complete as well as the express building adjoining and a part of the large central arch over the main entrance. The entire building when complete will be one of the largest and finest passenger stations in the South. The progress of the work has been delayed by the inability to secure the steel for the dome in the time contracted for. It was due to arrive more than a month ago. The manufacturers in Pittsburg, Pa., have for some time promised its immediate delivery. The large steel central dome will be a feature of the building and will occupy a great part of the contractor's time in constructing. Almost as much steel will be used in its construction as in the James sky scraper which is just completed. The steel beams which will uphold the massive dome are supported by concrete foundations laid on solid rock. The excavations for the foundations were over fifteen feet. It is estimated that the building will be complete in ten or twelve months and the Southern Road has let a contract for repairs to the old central shed costing three thousand dollars to tide it over this time. A new roof will be built over the shed and other necessary repairs made.

An interesting building now in course of erection is the Hotel Patten, a steel sky scraper at the block between Eleventh and Tenth streets, near Market. Work has started on the immense smoke stack for the boiler room. It is being built of reinforced concrete and it will be one hundred and sixty feet high. It will be four feet in diameter on the inside. This will be the largest and tallest concrete chimney in this part of the country. The contract was awarded to the Weber Steel Concrete Chimney Co., general offices, 929-934 Marquette Building, Chicago, Ill.

The Kennesaw Marble Company, of Kennesaw, Ga., secured the contract for furnishing marble for the Hotel Patten. Georgia, Tennessee and Italian marbles will be used in the construction of offices and lobbies of the new hotel.

The W. P. Nelson Co., of 241-242 Michigan avenue, Chicago, was awarded the contract for painting and decorating the Hotel Patten. All interior decorations will be made by this company.

The sub contract for the Crystal Springs Bleachery for lumber was let to the East Tennessee Lumber Company, of Chattanooga, of which J. Walter Peak is manager. The contract was let by Adams and Schneider, general contractors for the building, and was the result of competitive bidding by a number of lumber concerns. The bleachery is the plant promoted by Bowen and Jewell. The big bag plant of the firm at Chattanooga will later be merged in the bleachery which is being erected at Crawfish Springs, Chickamauga, Ga. Work on the foundations has already begun.

Charles L. Schofield, of Bridgeport, Ala., owner of a patent for making decorative glass for use in making jewelry, panels, and all ornamental glassware is considering starting a plant here for the manufacture of his invention. The glass has the appearance of agate and the finer grades of marble yet can be manufactured and sold at a much lower price than either article. Made in the delicate onyx tints it is hard to detect from that mineral. Mr. Schofield decided that Chattanooga is an ideal place for his plant.

TWO COUNTY TUNNELS THROUGH HISTORIC RIDGES.

Work has started on the proposed tunnels through two famous and historic ridges near Chattanooga. County officials have advocated for some time the advisability of tunneling these mountains and thus shortening important and much travelled highways. East of the Ridge lies Missionary Ridge, a long low mountain, scene of the world famous battle of Missionary Ridge. McCallie avenue, the main east drive though the city and county strikes the ridge at right angles and pedestrians and drivers are obliged to take a long and circuitous route to mount and descend. Contractor T. J. Shea started his steam shovel to work this week tunneling the ridge at the exact spot where McCallie reaches it. Mr. T. J. Shea expects to complete the big hole in eight or ten months. Dirt is now flying, "The Little Giant" throwing out gravel and sand and rock at a rapid rate. The matter is being used to widen McCallie avenue east of the city limits and it is proposed to secure enough dirt to widen the city end of the avenue also to at least sixty feet, making it a sixty foot boulevard for many miles in extent through the

Highest Stack in America.

Herewith we show a picture of the new stack at the works of the Eastman Kodak Co., Rochester, N. Y. This stack is 366 feet in height, the highest in America, and it rests on an octagon foundation which is 23 feet deep to bed rock, is 40 feet across the flat sides of octagon at base and 30 feet at top. The base contains approximately 23,000 cubic feet of concrete and weighs 1600 tons. The chimney proper is a round shaft built of hollow radial brick. The outside diameter at the bottom is 28 feet and at the top is 11 feet. The inside diameter at the bottom is 19 feet, and at the top 9 feet. It is lined on the inside with acid-proof brick and

cement 4 inches thick, leaving a two-inch air space. The lining is laid in sections 20 feet high, supported on corbels from the stack. The smoke opening is 6x12 feet, providing for 2,400 horsepower boilers, and the acid fume inlet, 4 feet by 4 feet, is for sucking away the acid fumes from the chemical manufacturing departments. The bricks used in stack are radial in shape and have hollow air spaces perforated in them. They are about 5 inches high and 6½ inch face. The length of the bricks varies from 10½ inches long to 4½ inches, there being five different lengths used. The stack is provided with lightning rod having four carbon points, and is equipped with an iron ladder on the inside and outside. The total weight of the stack is about 6,400,000 pounds, or 3,200 tons. The letters "Kodak" on the stack are 7 feet 3 inches high and are spaced 9 feet 9 inches center to center, the bottom of the lower K being 204 and top of the top K being 250 feet above top of foundation.

Popularity of the Steam Turbine

The rapidity with which the steam turbine has come into popular favor is one of the phenomena of modern steam engineering. It is less than a decade ago since the first turbine was sold in the American market, but there are today about 700 in use throughout the country, aggregating a total capacity of approximately 1,000,000 kilowatts or about 1,500,000 horse power. This wonderful demand for that novel prime mover is, of course, easily explained by the many advantages the turbine has over the reciprocating steam engine. An interesting test was conducting recently by the engineers of the New York Edison Company at the Waterside Station near 30th Street, which developed facts hitherto unattained by any steam prime mover in this country. The unit under test was a Westinghouse turbine of 10,000 horse power capacity. It had been sold under a steam consumption guarantee of 15.9 pounds of steam per kilowatt hour, but the test recorded the phenomenally low steam consumption of a shade less than 14.9 pounds per kilowatt hour. Apart from the fact that this result gained a bonus for the Westinghouse turbine of over $25,000, it is of the utmost interest to all users of steam engines as an illustration of the lowest record for steam consumption which has ever been recorded by a stationary steam engine. This steam consumption figures less than 1½ pounds of coal per kilowatt hour and graphically illustrates the great advance in modern power plant practice attained through the introduction of the steam turbine, the efficiency of which has been demonstrated in all respects to be superior to the reciprocating engines.—*Coal & Coke.*

Copper is stated to be so hardened as to take a cutting edge by adding to it, while in a molten state, about 2 per cent. of potassium ferrocyanide. The color is not affected. The reason for the change is not clear, but it is supposed to result from the introduction of iron and possibly carbon.

to render it unnecessary for the government to take up its manufacture at the Isthmus.

The general features and the design and details, not only of the Gatun, but also of the other locks throughout the Isthmus, have been determined upon and fully worked out, together with the general type and number of lock gates to be used. The survey of the country which will be inundated by the great Gatun Lake has been completed, and all the contour lines established. The area of the lake has been a growing quantity during these past few months, but it has now been finally established at the high figure of 171 square miles.—*Scientific American, Oct.* 5th.

Builds Factory in 29 Days.

IN these days of highly developed earning power of factories over-run and behind with orders, together with the high real estate values on factory sites within a radius of twenty miles of New York, speed in construction, it can be plainly seen, is a necessary and valuable essence in a building contract.

There has recently been completed at Newark, N. J., a lamp factory for the General Electric Co. On the 24th of the month ground was first broken by the contracting firm doing the work, and on the 23rd of the following month the building was finished and the manufacturers' machinery was being installed—29 calendar days, no nights nor Sunday work and a half holiday on Saturday for the skilled labor.

An additional feature of interest in the construction of this factory lies in the fact that an extra week's time had been granted to the contractors by the architect, of which the contractors did not avail themselves The footings were originally specified as four feet six inches deep, but owing to the discovery that the factory site had previously been occupied by an old tannery, these footings had to be made 16 feet and it was necessary to excavate large quantities of tan bark In spite of this handicap, the foundations in places being sunk to this additional depth, the contractors completed the work two days ahead of the original contract time and hence did not need the extra week allowed for the deeper foundations.

Another handicap which contractors had to overcome, was the provision in the specification that the foundations and walls of the first story should be strong enough to allow of additional three stories later on. This, together with the limitation of the ultimate pressure on the soil below, 5,000 pounds per square foot, made much heavier work necessarily than would have ordinarily been the case on the one story factory building.

The cost of the factory was approximately $50,000, with a bonus and forfeit clause and in one week of five and a half days the pay roll amounted to $6,000. About this time 400,000 bricks were laid in eleven working days, or an average of some 36,000 brick per day.

It is interesting that 230 men were employed in building this factory under the guidance of four brick foremen, four carpenter foremen and four labor foremen. Two time-keepers were continually employed and one of the members of the contracting firm was always present. When it is considered that no night work was done on this job, it is seen that the two time-keepers were an additional precaution showing the systematic cost-keeping methods.

One of, if not, perhaps, the most essential features of this speed construction, aside from the large force of men and ample superintendents, was the fact that the common Jersey hard brick, long leaf yellow pine, Portland cement, window frames, trim and in fact all materials were purchased in Newark, N. J., for immediate delivery and trucked to the job. It is claimed by Mr. Salmond, of the contracting firm, Salmond Bros., that in no other way would it have been possible to have constructed this building in anything like the record time required, except by calling upon their local business acquaintances with personal appeals.

An amusing incident in connection with this work was the method employed in rushing through the roofing work. At the same time that a four-inch tar concrete floor was being put in, two separate roofing contractors, one employing a Newark labor union, and the other a Brooklyn labor union, were engaged simultaneously on separate halves of the roof, racing, one against the other. The good spirit of the workmen and the enthusiasm of the rival unions contributed largely to the remarkable record. History does not state whether Brooklyn or Newark prevailed in this competition, but it was a welcome streak of humor in what had up to that time been a nerve racking ordeal for all concerned.

Railway Notes.

The "Little Giant" is one of several machines being used in grading the new extension of the M. & N. A. railroad, now being built from Leslie to Searcy.

$10,000.00 per mile is the price per mile being paid for the ditch it is digging across this hill.

About a ton of earth and loose stone is taken up each shovelful and is hoisted and emptied into cars which take it to the embankment some distance away.

The Atchison, Topeka & Santa Fe Railroad has gone into tree growing in order to provide for its future supply of cross ties. The Santa Fe has adopted the eucalyptus as the most suitable species for the purpose because of its rapid growth, great density and durability, and is now planting 700 acres in a ranch of 9,000 acres in Southern California to encalyptus seedlings, with the intention of repeating this each succeeding year for twelve years or more.

Each tree will, at the end of fifteen years, yield six ties, it is calculated, or some 3,300 ties an acre. These ties will be cut from 700 acres of the big orchard each year, after fifteen years from the first planting, with the result of obtaining more than 2,250,000 ties per annum; and, seeing that the rate of removal will be exactly equal to the rate of planting the same total acreage will, theoretically at least, maintain the same annual supply of ties to the end of time. The cost for each cultivated tie is far below that of ties of the best quality, such as white oak, now bought on the market.

Consul Albert Halstead, of Birmingham, reports that at a recent meeting of the Institution of Civil Engineers in England the question of the chemical composition of steel rails in order to insure the highest durability and perfection was considered. An opinion was expressed by one of the members that a universal specification for rails which would suit all cases could not be arrived at owing to the varying conditions of manufacture and service. A high percentage of phosphorus constitutes an element of danger in spite of the good wearing qualities of high phosphoric rails, and sulphur is always liable to cause incipient flaws. No more manganese should be allowed than is necessary for clean rolling, as many cases of rail fracture are attributable to high manganese, while an excess of silicon produces brittleness and irregularity of percentage. Engineers now limit the silicon to 0.1 per cent, or even less. The effect of added silicon is different from silicon left in the pig iron, and when the silicon from the pig iron had been eliminated as far as possible and a known quantity of this supbstance added in the form of high percentage silico-spiegel or ferro-silicon, the silicon toughened the steel.

As the overland traveler views from the observation end of the limited trains, the variegated colors of the disintegrated granite of which the greater part of the Union Pacific is ballasted, he often wonders from whence it comes. At the summit of the Rocky Mountains, where the Union Pacific crosses the range, at an elevation of eight thousand and eleven feet, the granite has succumbed to the elements and although the rocks retain their original shape the life, is gone. A blow from a maul, or from a stick of dynamite is only necessary to prepare them for loading upon the cars with immense steam shovels.

Of all the large sums spent for the comfort of the overland travel, in eliminating curvature, rectifying grades and bettering a railroad, none is more appreciated by the public than the "elasticity" of this class of gravel. Nearly all races and classes have contributed their share of labor in placing the ballast here in the most scientific manner. Bridging in a night the monotonous expanse of desert, the peculiar virtues of this ballast are perhaps more appreciated by the sleeping passenger just freed from the vibration of the solid rock ballast of many eastern lines. At Creston, at an elevation of seven thousand, one hundred

The Schmidt Drive Chain.

Drive chains, known as "silent chains," have become very important in the power transmission field. They have this position because they are silent, and due to their ability to adjust themselves to the wheels as they lengthen, retaining their full efficiency until completely worn out. At the same time they give a positive, flexible drive on short and long centres, at slow and high speeds, unaffected by damp, grease, dust or heat.

The Schmidt Chain, herewith illustrated, is the latest development of this type. It combines great capacity, durability and simplicity of construction, and runs smoothly and silently with the least consumption of power.

It is constructed of multiple toothed links stamped from special high carbon steel, case-hardened steel pins and pin retaining links.

The tooth of the link is placed central between the pins, giving a straight path for the stress to follow. Consequently the links being straight are in tension only, and will not bend and change their pitch under excess or suddenly applied loads. It follows that for a given load the chain is lighter, giving less dead weight and high efficiency. The faces under the pins are of a sufficient angle so as to clear the corners of the wheel teeth, and adapt the chain for any size wheel.

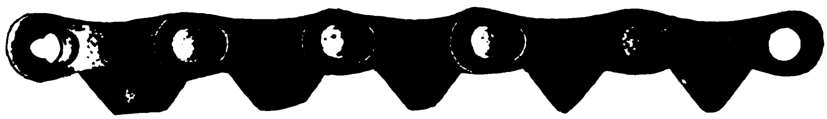
The outer end of each pin orifice in the links has the same radius as the pins. The links therefore always have arc bearings on the pins, giving a large bearing suface, and doing away with the excessive wear in the new chain, resulting from the use of a circular hole of larger diameter than the pin, which gives but a line bearing until the metal wears and forms a seat for the pin.

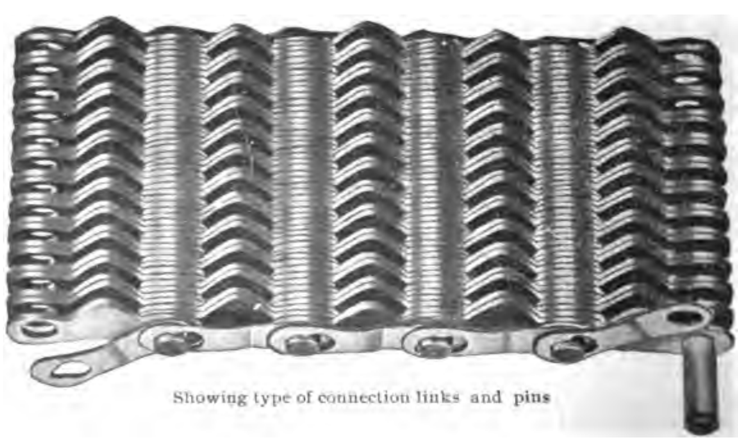
The method of retaining the pins, exclusively used in these chains, is novel and interesting. They are not riveted, but are retained by means of special edge links, called retaining links. These are thinner than the chain links and have one hole keyhole shaped, which passes over the end of the pin and enters the circular groove. The retaining links are offset and overlap, and lock each other as well as the pins in place. By this construction the chain is surely held together and yet is easily detachable for general overhauling, or changing its length, without the use of tools.

The pins require no annealing at their ends and are consequently free from soft spots and resist wear equally for their full length.

The wheels on which these chains run, have symmetrical cut teeth, the number being limited only by the capacity of the cutting machine. Very large speed ratios are consequently possible, 20 to 1 being well within the limits. A drive can readily be reversed and the chains need not be placed on the wheels in any explicit manner.

The Schmidt chains also have the faculty of riding out on the wheel teeth, as their pitch lengthens, automatically forming a larger pitch





Showing type of connection links and pins

Motor Driven Dump Cars.

IT may be of interest to the readers of this journal to observe in the accompanying cuts how electricity as a motive power can be successfully applied to various forms of dump cars for narrow gauge railway purposes. While motor driven cars have been used to a certain extent in the past, there now seems to exist a general awakening as to the possibilities of such equipment for industrial haulage use in preference to the more complicated and expensive methods of the transportation commonly employed, such as belt conveyors, elevators, cranes, etc.

Appreciating the wide field of application for this class of equipment the Cleveland Car Co., at West Park, Ohio (Cleveland) has specialized largely in the manufacture of electric driven cars and has met with unqualified success in their efforts in this direction. The building of such cars is no longer an experiment but an absolute and reliable feature of the business of this company in addition to its already varied and extensive operations in other branches of industrial railway equipment construction.

Nothing could be more simple and effective in the handling of material than the installation of a tramway system leading to and from remote portions of a manufacturing plant by means of which expensive trucking can be entirely eliminated, and the danger of personal injury to employees greatly lessened as compared with overhead conveying.

The element of danger mentioned is especially evident in foundry work where molten metal is handled on overhead trolleys or cranes with oft times serious accident and injury to workmen and the same is also true in steel mill work in the many dangerous and precarious positions in which operators are placed.

The above merely gives an idea of one of the great benefits which can be derived from equipment of this character and no small importance can also be attached to the items of installation, cost, maintenance and resultant saving in labor produced through its use.

The two illustrations shown herewith will serve to show to good advantage the individual construction of cars of this design with which a word of explanation may be acceptable. Cut No. 117 depicts a special one side dump car built for handling coal from storage bins to boiler rooms having a capacity of three tons and arranged with the body sloping on each end as well as on one side so that the contents of the car can be discharged through a comparatively small door into stokers, hoppers, etc. The angle of dump is such that the mere weight of the load is all that is necessary to accomplish this.

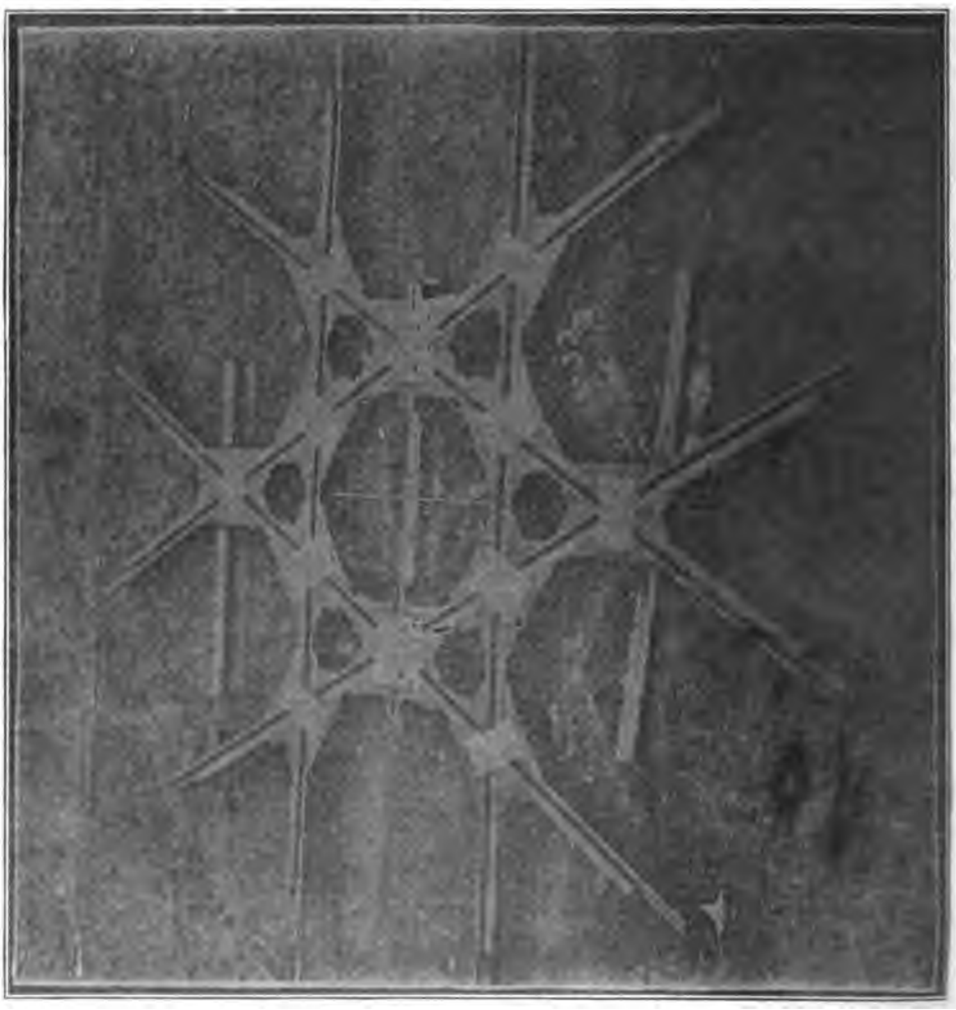
The body of the car is carefully proportioned and strongly built of tank steel plate and structural material, being mounted on a channel frame and rigidly held in position. The door (not shown in cut) is hinged at the top and locked in place by a pivoted lever.

An Unusual Railway Terminal Device.

THIS is not a shooting star, but one which revolves, stops and turns again. It is probably the first and only six pointed geometrical figure ever put to use in solving railway engineering difficulties.

There is now being installed by a North Jersey railway an unusual terminal device for the reversing of their cars. Instead of the old method, familiar to many who ride daily to and from their business, this company is putting into operation an arrangement whereby all incoming cars will pass upon a 32 foot electrically driven turntable and be immediately swung around to a position ready for the return trip, the motorman remaining at his post, at one end of the car.

On the top of this turntable three lines of track converge and meet at a common point at the centre, thus forming a most remarkable railway crossing, having twelve intersections and twelve extending arms, as shown in the illustration. This is without doubt the largest and most difficult single piece crossing ever constructed for any railway.



An Unusual Railway Terminal.

The Industrial Magazine will be raised in price to $2.00 January 1st, 1908.

"I believe that the only hope we have to keep this nation in the front industrially, is to push industrial education with might and main, and not wait very long before beginning.

"All trades should be taught. The trade school should teach its students the principles of the respective trades in question, together with enough practical manipulation, to make the student self-supporting from the start after leaving the school. It should also give him a general education, so as not to get the student into grooves."

Frank C. Caldwell, Vice-President, H. W. Caldwell & Son Company, Engineers, Founders and Machinists, Chicago: "Owing to union restrictions and a number of other reasons, there is very little opportunity for boys to acquire the special training necessary to fit them as practical workmen in some specific trade. We certainly think there is a promising field for a number of such schools. * * * We are quite certain that the graduates of such a school would be much better equipped as all round workmen than the average apprentice at the end of his term, or the average workman who has picked up his trade in actual practice. We are inclined to favor the general school as distinguished from the special school."

Robert H. Jeffrey, Vice-president, Jeffrey Mfg. Co., Columbus, Ohio: "The desire to take advantage of the apprentices in order to secure the most production from them, has caused the manufacturers to fail in giving them proper instructions to insure mechanical knowledge and efficiency."

Eldon B. Keith, George E. Keith Co., Campello, Mass.: "So far as the shoe industry is concerned, we are strongly in favor of this movement, and believe that when once established it will prove a great benefit to our industry."

John Golden, General President, United Textile Workers of America, Fall River, Mass.: "I can safely say that organized labor is not and never will be opposed to industrial education properly controlled and scientifically administered. * * * Rest assured that the labor unions will at all times oppose trade schools of the character I have mentioned, (corporation schools—'scab hatcheries,' Mr. Golden calls them), but will further a movement for more opportunities for industrial and technical education."

John Fitzpatrick, President Chicago Federation of Labor: "I am in favor generally of industrial education. I believe that all trades can be taught. * * * I favor preparatory trade school work under public auspices, but do not favor trade schools conducted by manufacturing concerns."

Henry Abrahams, Secretary Central Labor Union, Boston, Mass.: "Personally, I am of the opinion that the trade school is coming, hence we must recognize the inevitable. If we were to take the children of twelve and for two years to teach them the use of tools, they would find themselves better fitted for the battle of life. There should be evening schools for men in engineering, electricity, plumbing. I am opposed to trade schools run by private corporations."

Emma Stehagen, Secretary Women's Trade Union League, Chicago, Ill.: "I am in favor of industrial education if carried on in the proper manner, by which I mean under the auspices of the public schools and giving practical teaching. The trades union movement stands for the uplifting of the worker, and I believe an industrial education is one of the aids of trade unionists. If schools are conducted by manufacturing concerns * * * * they are to be deprecated."

Henry Sterling, Secretary Boston Typographical Union No. 13, Boston, Mass.: "There is a demand in every trade for good workmen, but little opportunity in industry for one to become efficient. No trade can be taught in a school, but much that will tend to better and more efficient work can be taught. I believe that public trade schools a just charge on the public treasury, but I do not favor evening trade schools. Rather I favor a part time system, half day at work, half day in school."

I. B. Armstrong, Master Workman, L. A. No. 3662, Knights of Labor, Lynn, Mass.: "It would seem in order to obtain the greatest results or benefits from trade schools, that practical experience in the trade should be made a condition or prerequisite for admission to the trade schools, with the possible exception of the graduates of the public schools in the locality. The limiting of applicants to the school to those already engaged in the business would be necessary in order to prevent the overcrowding of the industry. I do not favor trade schools conducted by manufacturing concerns."

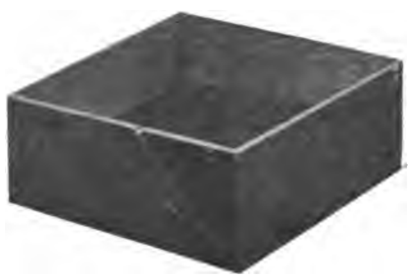
John F. Tobin, General President Boot and Shoe Workers Union, Boston: "I am in favor of public education conducted at the public ex-

the floor, and that millions of bacteria will thereby be liberated to be driven about the shop with every gust and draught, the importance of cuspidors is appreciated. There are two kinds; one made of heavy waterproof paper, which can be burned, and the other of metal. Both of them should contain water,

Metal type of Cuspidor, perpendicular sides. Cut shows removable top. Size across top, 10 inches.

and the metal one should be thoroughly cleaned every day, and if possible, exposed to the sunshine. An unsatisfactory makeshift for these is a box filled with moist saw dust.

These cuspidors may be ordered through hardware or specialty dealers, or they may be obtained through the Welfare Department of the National Civic Federation, 281 Fourth Ave-



Heavy paper type of cuspidor. Holds water. Cuspidor and contents burned every three or four days, or oftener. Size across top, 8 inches.

nue, New York City, or through the Workshop Improvement Committee of the Civic Federation of New England, 101 Tremont Street, Boston. Printed cards like the illustration may also be obtained of the same associations, at cost price.

Readers are specially advised to communicate with Dr. Livingston Farrand, Secretary, National Association for the Study and Prevention of Tuberculosis, 105 East 22nd Street, New York City, who will give full information on this important subject.

PLEASE DO NOT SPIT ON THE FLOOR

TO DO SO MAY SPREAD DISEASE

CUSPIDORS ARE PROVIDED IN THIS ROOM

NOTE—Regular size of this card is 8 by 10 inches.

The greatest stronghold of tuberculosis is among the working population, and it claims its victims from the families at home, as well as from the workers themselves. If every employer will awake to a full realization of his responsibility and opportunity to help stamp out this disease, which causes more deaths than any other, the results cannot fail to be seen in decreased mortality and in greater efficiency in the workshop.

A New Phase of Welfare Work.

The work of the Welfare Department of the National Civic Federation in factories is well known to every employer of labor. Indeed it is owing largely to the efforts of this organization that so much has been accomplished in the last few years.

A new committee has recently been organized by the Federation, known as the National Committee on Welfare Work for Government Employees, the object of which is to create an interest in improving the working conditions of Federal, State and municipal employees. The officers of the committee are:

Chairman, William H. Taft, Secretary of War.

First Vice-Chairman, John C. W. Beckham, Governor of Kentucky.

Second Vice-Chairman, George W. Guthrie, Mayor of Pittsburg.

Third Vice-Chairman, William R. Willcox, Chairman of the Public Utilities Commission of New York City.

Secretary, Miss Gertrude Beeks.

The committee is composed of State and municipal officials, who have to do with the working conditions of public employees, chairmen of boards of health, heads of departments of public safety, leading physicians connected with public hospitals, heads of charity boards and others.

There are many types of employees to be benefitted by the efforts of this new committee. Among those employed in the different departments, the navy yards, arsenals, State and city institutions to be affected are: Clerks, sailors, soldiers, printers, machinists, carpenters, postmen, firemen, policemen, bricklayers, iron workers, moulders painters, plumbers, pattern makers, engineers, chemists, blacksmiths, boilermakers, crane men, hospital orderlies and trained nurses.

The subject of pensions, in which all government employees are keenly interested, will be given consideration. In every department this is a live issue, and there are organizations of government employees which were formed for the purpose of securing Congressional action.

One of the most important matters to which the committee has so far given its attention was an investigation of the conditions surrounding employees of the government on the Isthmus of Panama, including arrangements for housing, feeding, amusements, social life and other matters. The investigation was made by Miss Gertrude Beeks, Secretary of the Welfare Department of the National Civic Federation, and upon her report being made, President Roosevelt requested her to return to Panama within eight months and to make a further report upon the progress noted in accordance with her suggestions.

Miss Beeks' report was thoroughly covered in the newspapers, and accordingly we do not attempt to summarize it here. It is well to remark, however, upon her common-sense method of making inquiries of workmen who remained upon the Isthmus, rather than of those who had become disgruntled and left. She found much to praise, and especially dwelt upon the fact that the army engineers that are now in charge of the work are administering it in strict accordance with the idea of a square deal, both to the public and to the working man on the job.

Miss Beeks looked at conditions from the standpoint of a woman, and brought a woman's sympathy to bear on the problem. Such little matters as drying rooms for clothes, greater cleanliness in the dormitories and boarding houses, canal newspapers in various languages and a center of amusement for employees off duty, all seem trivial when taken separately, but their sum total determines the possibility of keeping competent labor on the Isthmus.

Determination of Stresses in Web and Stiffeners of Girders.

PROF. F. E. TURNEAURE, M.W.S.E.

The design of plate girder stiffeners is one of the few features of structural design which does not lend itself reasonably well to theoretical treatment. While most of the rules of practice are based on certain rough methods of theoretical analysis the theories employed neglect such important factors that the results are unsatisfactory and vary greatly among themselves. The problem is one that, in the nature of the case, must be solved largely by experiment. It is the purpose of this paper to contribute something towards its solution by presenting results of certain experiments on plate girder webs and stiffeners, together with such theoretical discussion as may assist in interpreting the results.

The experiments consisted in numerous measurements of the distortion of the stiffeners of a plate girder under actual railroad traffic, and measurements of web-plate distortion of a special experimental girder tested in the laboratory. The work was done under the author's direction as thesis work and as special laboratory investigation at the University of Wisconsin. The latter work was carried out in detail by Mr. W. S. Kinne, instructor in the university, who has also assisted very greatly in the preparation of the results for publication.

Theoretical Stresses in Web Plates. As an aid in judging of the significance of the experimental results a brief statement will first be given of the usual theory of web stresses for a plate girder without stiffeners. It will be assumed that the web plate remains perfectly straight and that the flange and web are rigidly united so as to act as a solid section.

(a). The shearing stress per square inch at any point in the girder is of the same amount on vertical and horizontal planes and is given by the equation

$$S = \frac{V}{I\,b} \sum_{c'}^{c} ay \qquad (1)$$

In this equation V = total vertical shear, I is the moment of inertia of the section, b = width of beam at given point and

$$\sum_{c'}^{c} ay$$

is the statical moment of the area of the cross-section outside of the given point taken about the neutral axis. The variation of such shearing stress for a girder of usual proportions is represented in Fig. 1. The usual assumption that the shearing stress is uniform throughout the web is seen to be nearly correct.

(b). The tensile and compressive stresses on vertical planes (stresses constituting the resisting moment) vary directly with the distance from the neutral axis, being zero at such axis. (See also Fig. 1).

(c). Tensile and compressive stresses on planes inclined at other angles are given by the equation

$$t = \tfrac{1}{2}p\,(1 - \cos 2\theta) + v \sin 2\,\theta\ {}^{*} \qquad (2)$$

in which p is the horizontal unit tensile or compressive stress, v the unit shearing stress at the given points as found by eq. (1), and θ is the angle which the given plane makes with the horizontal. At the neutral axis the tensile and compressive stress is a maximum on a plane inclined 45 deg. from the horizontal and is equal to the shearing stress. At other points the maximum intensity is at some angle greater or less than 45 deg. + v. Figs. 1 and 2 represent the variation in compressive stress along a 45 deg. line, assuming the shearing intensity at the neutral axis to be one-half the maximum tensile or compressive stress at the extreme fibre.

It is thus seen that in the web plate the tensile and compressive stresses on a 45 deg. line

*Merriman's Mechanics of Materials, 9th Ed., p. 151.

10 to 18. A large majority of the locomotives were of one of the three classes known as R, R-1 and D. Diagrams of these classes are given in Fig. 4. Class D was used on passenger trains and classes R and R-1 on freight. The weights of classes R and R-1 are so nearly equal that for our purposes it will be unnecessary to distinguish between them. No difference in results could be noted. These were the heaviest locomotives used. Results from other locomotives varied considerably from these, but were generally smaller. They are widely scattered and not readily comparable so they will not be given here.

Complete data are given in Table No. 1 for five stiffeners, these results being typical. In all cases the maximum ordinate of the deformation curve is given in inches and then the calculated stress per sq. in. corresponding to this value, assuming a modulus of elasticity of 30,000,000 lbs. per sq. in. The minus sign indicates tension.

There is usually a fair agreement among the several results on the same stiffeners, but on No. 8, and in the case of some others, the results are erratic. With such low values this is not surprising. The speed of all freight trains was slow and for the passenger trains generally from 30 to 45 miles per hour.

It will be noted that stiffener No. 4 showed tension on the inside and compression on the outside, indicating a bending or buckling tendency. This was observed in others.

In Table No. 2 are given, in a condensed form, the results on all the stiffeners. Average values are given for the stresses, obtained as above described, for the three classes of engines considered.

Examining the results in detail it will be noted that in the end stiffeners, Nos. 1, 2, 17 and 18, there is considerable axial compression, as would be expected, owing to the local concentrations. These stresses are heavier in Nos. 2 and 17 than in the stiffeners at the extreme end. This also is to be expected. Stiffeners Nos. 3, 4, 15 and 16 are again alike in that they all show considerable bending, with tensile stresses on one side and compressive stresses on the other. The axial stresses are small, being mainly tension. Nos. 6, 8, 11 and 13 show considerably less bending and small resultant stresses. It is to be further noted that the axial stresses in all these stiffeners are about the same at one end as at the other, indicating that the direction of movement has little effect.

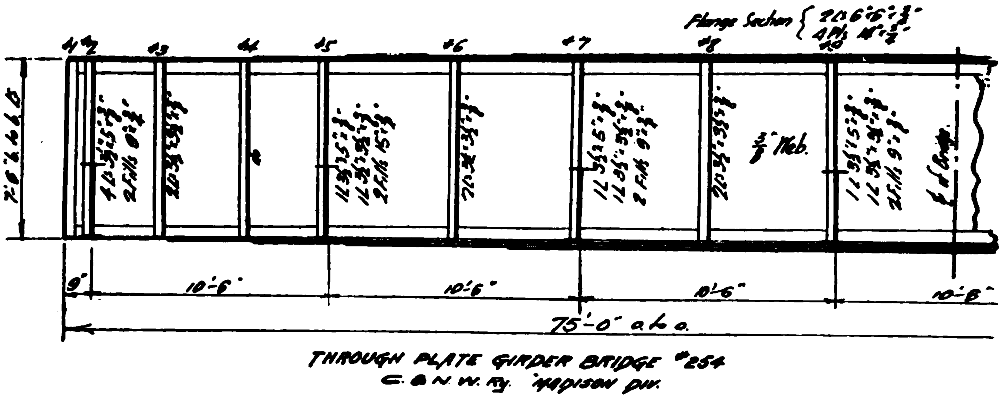


Fig. 3.

The intermediate stiffeners to which floor-beams are attached, Nos. 5, 7, 9, 10, 12 and 14, all show tensile stresses on the outside angle. Probably the axial stress is also tensile, as the gusset plate would prevent much bending. Fig. 5 is a diagram of the axial stresses from Table No. 2 for the freight engines. It represents quite clearly the general conditions.

The results of these experiments would seem to show quite conclusively:

(1), that under ordinary working conditions the axial stresses in intermediate stiffeners, subjected to no local loading, will be very small—practically nothing,—but that these stiffeners are likely to be subjected to some bending;

(2), that stiffeners at points of concentration (end stiffeners and stiffeners supporting floor-beams) will be stressed in a manner de-

pending upon the direction and point of application of such concentration. These results are what would be expected from theoretical considerations. As shown at the beginning, the theoretical tensile or compressive stresses on vertical lines are zero. Hence it follows that stiffeners riveted on the web in a vertical position cannot receive direct stress. They aid of course in preventing bending of the web, as indicated by the bending stresses to which they are subjected. Stiffeners at points of load concentration will receive stress as the web stresses at such points involve more or less direct stress on vertical lines.

LABORATORY EXPERIMENTS ON A SPECIAL GIRDER.

To carry the work a step further a special girder was constructed in accordance with the drawing of Fig. 6. The girder was built by

Table No. 1. Typical Results Obtained on Stiffeners.

Stiffener No. 1.

Position of Angle.	Class of Engine.	Max. Ordinate. Inches.	Stress per sq. in. Pounds.
Inside	Freight................	.08	440
		.08	440
	Passenger....	.04	220
		.06	330
		.08	440
Outside	Freight...............	.17	930
		.18	980
		.10	550
	Passenger...	.12	650

Stiffener No. 2.

Position of Angle.	Class of Engine.	Max. Ordinate. Inches.	Stress per sq. in. Pounds.
Outside	Freight........	.24	1300
		.24	1300
	Passenger	.22	1200

Stiffener No. 4.

Position of Angle.	Class of Engine.	Max Ordinate Inches.	Stress per sq. in. Pounds.
Inside	Freight..............	−.28	−1530
		−.30	−1630
	Passenger.......... ..	−.24	−1300
Outside	Freight	.20	1090
		.22	1200
		.24	1300
		.26	1400
		.28	1550
	Passenger.............	.16	872

Stiffener No. 5.

Position of Angle.	Class of Engine.	Max Ordinate Inches.	Stress per sq. in. Pounds.
Outside	Freight....	−.22	−1200
		−.22	−1200
		−.14	−820
	Passenger	−.18	−980
		−.24	−1300

Stiffener No. 8.

Position of Angle.	Class of Engine.	Max Ordinate Inches.	Stress per sq. in. Pounds.
Inside	Freight	.06	330
		.03	160
		.01	50
	Passenger.............	−.08	−440
		−.10	−540
		−.10	−540
		−.10	−540
Outside	Freight........	.01	110
		−.04	−270
		.03	160
		−.06	−330
		.01	110
		−.04	−270

Table No. 2.—Average Results for all Stiffeners.

No. of Stiffener	Class of Engine	Position of Angle	No of Observations	Aver. Max. Stress Lbs. per sq in.	Aver. of Inside & Outside Angles, Axial Stress
1	Freight	Inside	2	440	630
		Outside	3	820	
	Passenger	Inside	3	330	490
		Outside	1	650	
2	Freight	Outside	2	1360	1360
	Passenger	Outside	1	1200	1200
3	Freight	Inside	3	1040	—515
		Outside	2	—2070	
	Passenger	Inside	1	1090	—980
		Outside	1	—3050	
4	Freight	Inside	2	—1580	—140
		Outside	5	1300	
	Passenger	Inside	1	—1300	—215
		Outside	1	870	
5	Freight	Outside	3	—1090	—1090
	Passenger	Outside	2	—1140	—1140
6	Freight	Inside	4	540	50
		Outside	2	440	
	Passenger	Inside	—	—	—
		Outside	1	- 980	—
7	Freight	Outside	3	—940	—940
	Passenger	Outside	1	—1630	—1630
8	Freight	Inside	3	160	55
		Outside	6	—50	
	Passenger	Inside	4	—540	—540
		Outside	1	—540	
9	Freight	Outside	2	—1040	—1040
10	Freight	Outside	1	—870	— 870
11	Freight	Inside	7	220	30
		Outside	5	—160	
	Passenger	Inside	1	650	190
		Outside	2	—270	
12	Freight	Outside	4	—980	—980
	Passenger	Outside	1	—1200	—1200
13	Freight	Inside	3	—160	—245
		Outside	4	—330	
	Passenger	Inside	1	—650	—760
		Outside	2	—870	
14	Freight	Outside	2	—980	—980
	Passenger	Outside	2	—870	—870
15	Freight	Inside	2	620	—505
		Outside	4	—1630	
	Passenger	Inside	1	540	—650
		Outside	1	—1850	
16	Freight	Inside	10	1030	—110
		Outside	2	—1250	
	Passenger	Inside	1	980	—625
		Outside	2	—2230	
17	Freight	Outside	3	1470	1470
18	Freight	Inside	1	—540	930
		Outside	1	2400	
	Passenger	Inside	2	—760	760
		Outside	1	2280	

the Wisconsin Bridge Company and in details it is largely the design of Mr. Andrews Allen, of that company. Test specimens of the web material showed an ultimate strength of 50,300 lb per sq. in—a yield point of 37,700 lb. per sq in. and an elongation of 25 per cent; specimens of the flange material showed an ultimate strength of 60,700 lb. per sq. in. and a yield point of 45,000 lb. per sq. in.

The capacity of the testing machine available for the work was 100,000 lb. and it was the aim to secure a girder as large as could be handled in this machine and one whose web would be the weakest element. A web thickness of ⅛-inch was used with flanges very strong and thoroughly riveted to the web. It was the purpose in this experiment to study stresses in a web unsupported by stiffeners, both within and beyond the elastic limit. Stiffeners were therefore used only at points of loading and at supports. It was intended to apply loads at first at the center and then, if necessary to cause rupture, at the quarter point. Permanent stiffeners were therefore placed at the center, but at the quarter point the stiffeners were not put on till needed. They consisted of angles well bolted to the girder with machine bolts.

From the figure it will be seen that the unsupported depth of web was 14 inches. The actual thickness was 0.14 in. so that the ratio of unsupported depth to thickness was 100. The

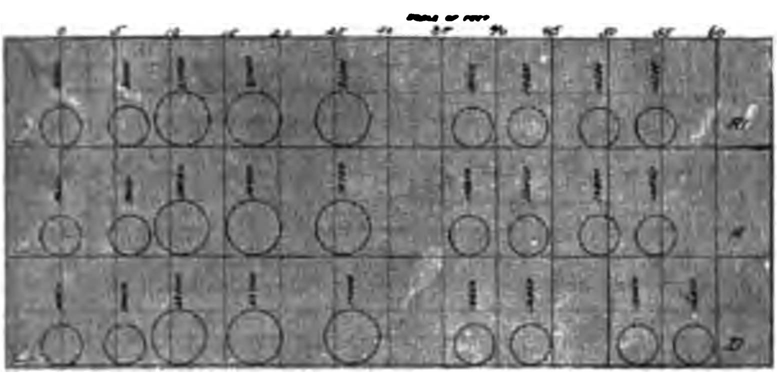


Fig 4—Engine Diagrams.

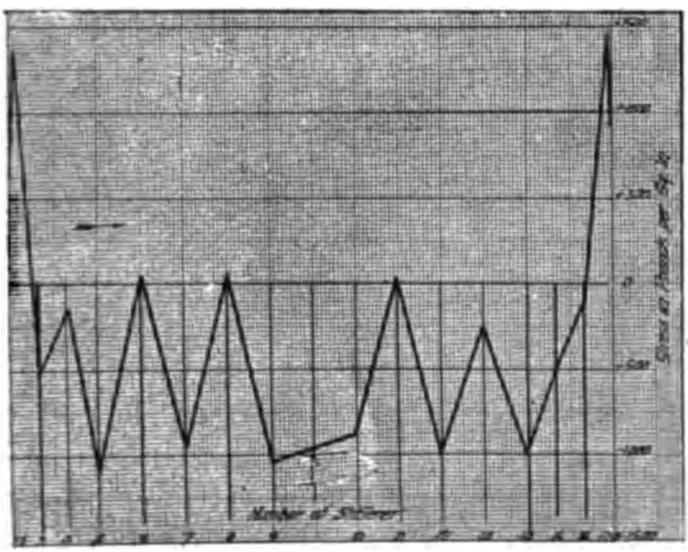


Fig. 5.
Average Axial Stress in Stiffness Under Freight Engine (from Table No 2)

unsupported length without the stiffeners at the quarter point was 6 ft. 2 in. and with such stiffeners it was 2 ft. 7 in.

The first series of tests consisted in the application of loads at the center by increments, with measurements of web distortion by extensometers. These distortions were measured on several diagonal and vertical lines as shown on Fig. 7. Two dial extensometers were used, one attached to each side of the web, readings being taken over a length of about 10.5 in. vertically and 15 in. diagonally.

Several runs were made with a maximum load limit of 50,000 lb. in order to obtain distortions over the several lines shown in Fig. 7 without causing permanent deformation. The results of these series are given in Table No. 3, in Fig. 7, and in the curves of Figs. 8 to 16. In Table No. 3 the stresses per square inch are calculated on the basis of 30,000,000 for the modulus of elasticity and for the center load of 50,000 lbs. Average results are given in Fig. 7, and in the diagrams, typical load-deformation curves are plotted giving the actual readings of extensometers and the average or resultant deformations. The stresses in Table No. 3 and in Fig. 7 are calculated from average deformations of the pair of extensometers and therefore represent closely the axial stress.

In Fig. 17 is given the theoretical distribution of the shearing stress over the web in this case. The theoretical tensile and compressive stresses on 45 deg. lines, as already shown, average the same. On this basis the dotted lines are drawn in the diagrams Figs. 8-16, representing the theoretical deformations. For the vertical lines (Fig. 7) the theoretical stresses are zero.

Noting some of the results in detail it will be seen that in most cases the readings of the two opposite extensometers differ greatly. In Figs. 8 and 11, for example, one shows considerable tension and the other about an equal compression. The average is nearly zero. In Figs. 9 and 15 the results are likewise of opposite sign, but the averages show considerable elongation, corresponding to the tension on the 45 deg. diagonal. This large difference in readings of the two extensometers is, of course, due to the warping or bending of the web, causing a movement of extensometers of opposite sign. This does not necessarily indicate a buckling due to over-stress but only a change in condition in the web from its initial condition. As a matter of fact the web was more or less warped initially, as all webs are. This is shown for various sections in Fig. 18. The bending of the web may thus be quite as much a "straightening" as a bending. As this tendency appears to be greater on the tension diagonals than on the compression diagonals the action would in fact appear to be more a straightening than a bending.

The actual amount of bending is not great, as the extensometers were so connected as to record the deformation at a considerable distance from the axis, about 2 inches.

There is no indication of a stress exceeding the elastic limit for the load of 50,000 pounds. The resultant curves are practically straight lines and the different runs give practically the same results. Examining the results shown in Fig. 7 it will be noted that the average diagonal compressive stress is somewhat larger than the conjugate tensile stress, the difference varying from 500 to 3200 lbs. per sq. in. The

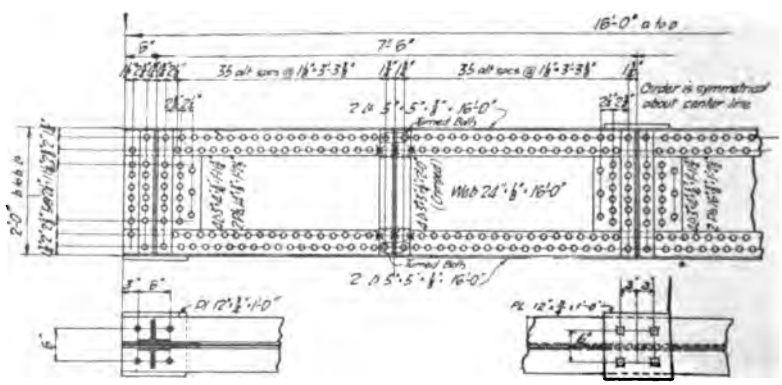


Fig. 6.
Special Experimental Girder.

vertical stresses range from 800 to 1380 lb. per sq. in The theoretical average diagonal stress is about 8300 lb. per sq. in.

There is thus some excess of actual over theoretical stress, but considering the nature of the experiments the results may be considered as a satisfactory agreement with theory. It is to be noted further that the effect is the same at points near and remote from stiffeners. Doubtless the excess of distortion over the theoretical is due to the bending and warping action of the web.

Following the series of tests described, loads were then applied up to a maximum of 100,000

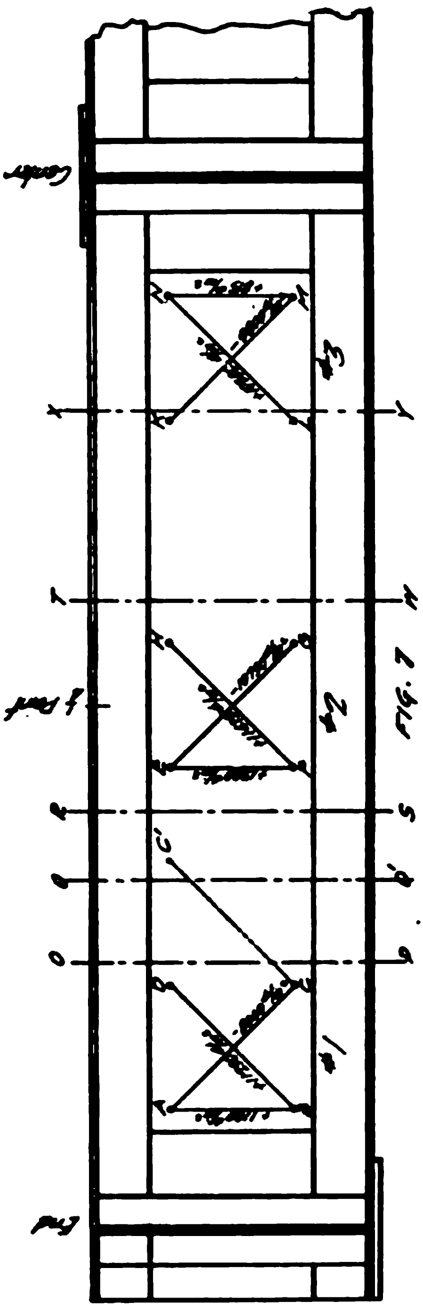


FIG. 7

DIAGRAM OF GIRDER SHOWING WEB STRESSES FOR 50000 LBS AT CENTER OF BEAM CALCULATED FROM WEB DISTORTIONS E = 30000000 #/in²

TABLE OF STRESSES (FIG. 7)

Line	AB	AC	BD	EF	EO	FH	MN	KM	LN
1st Run	1090	8220	11300	1170	10900	12150	850	9750	10350
2nd "	1270	7620	11200	1800	10600	10800	780	10050	10350
3rd "		8300		1170				9600	
Average	+1180	-8040	+11250	+1380	-10750	+11475	+815	-9800	+10350

+ Denotes Compression - Denotes Tension

Fig. 7 and Table No. 3
Stress in Experimental Girder under Center Load of 50,000 Lbs.

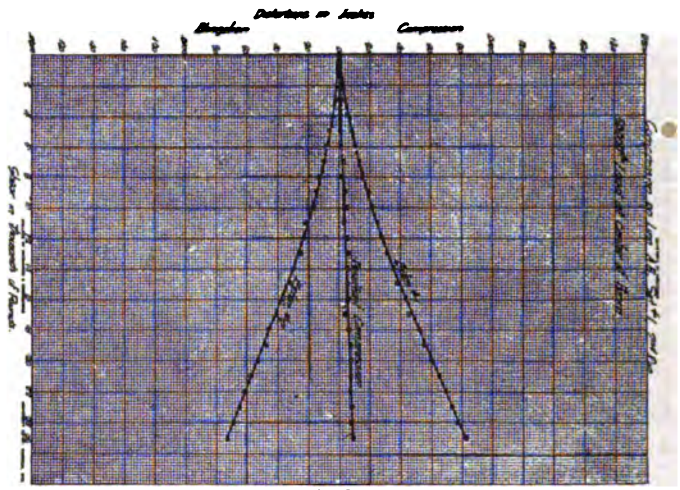


Fig. 8.

pounds at the center. Elongation line E G and compression line F H were measured. The results are shown in Figs. 19 and 20 with theoretical lines as before. Averages only of the two extensometers have been shown. In these curves there appears to be a marked elastic limit point at from 30,000 to 32,000 lbs. shear. (60,000-64,000 pounds load). The compression on line F H on a second run is given in Fig. 21. This indicates generally an increased deformation. The condition of the web as to buckling is shown in Fig. 18. This indicates a large permanent deformation under 100,000 pounds center load.

The load was now shifted to the quarter point and 100,000 pounds applied. Measurements were made on line C C′ (Fig. 7), with results shown in Fig. 22 and buckling effects as shown in Figs. 23 and 24. The permanent distortion was now excessive under the shear of 75,000 pounds.

Upon the completion of a testing machine of larger capacity the test was continued to rupture with results as shown in Fig. 23 and in the photographs of Figs. 25 and 26. The girder failed primarily by buckling in a series of sharp wrinkles, but ultimately by the web tearing apart on lines about at right angles to

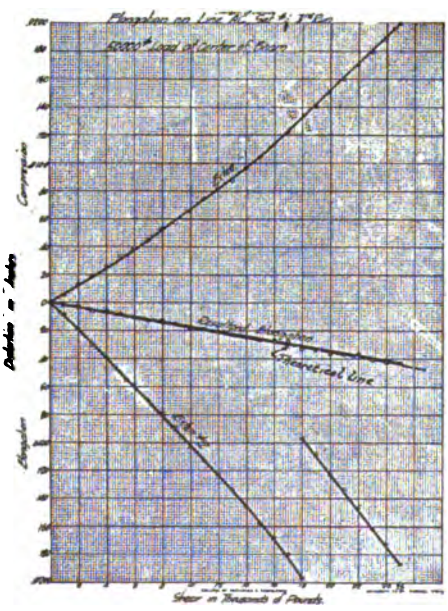


Fig. 9.

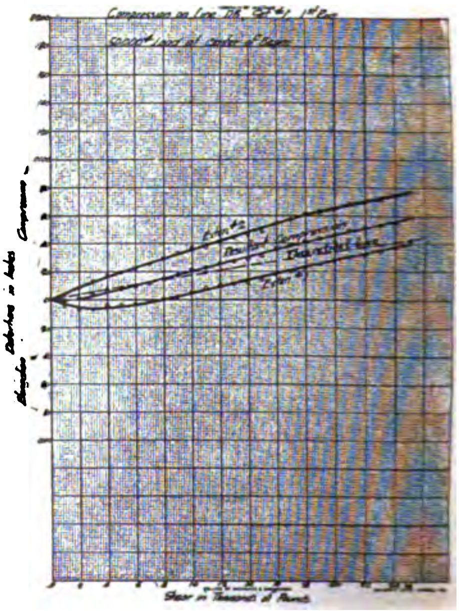


Fig. 10.

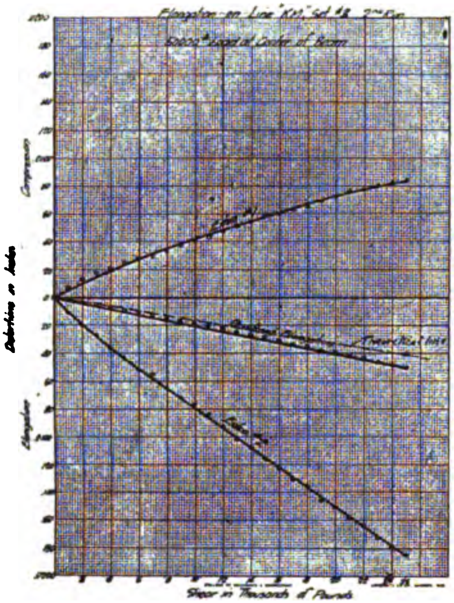


Fig. 15.

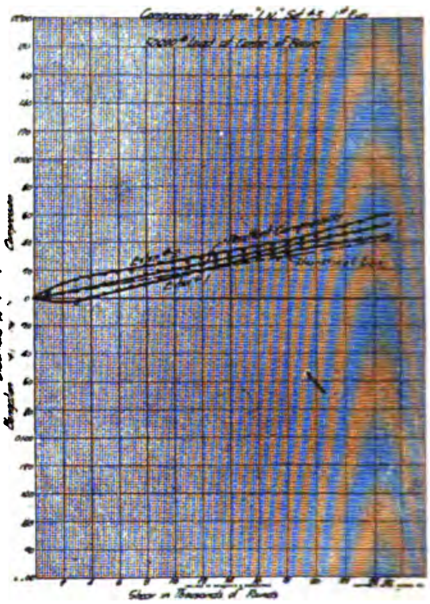


Fig. 16.

large flanges, a value of 75,000-80,000 pounds may be considered as a more significant measure of the web strength.

On the assumption of stress variation of Fig. 17 the average shearing stress in the web at these different stages would be as follows:

Total Shear Pounds.	Ave. Shearing Stress in Web between Flanges, per sq. in.
25,000	8,300
30,000	9,930
80,000	26,500
104,700	34,700

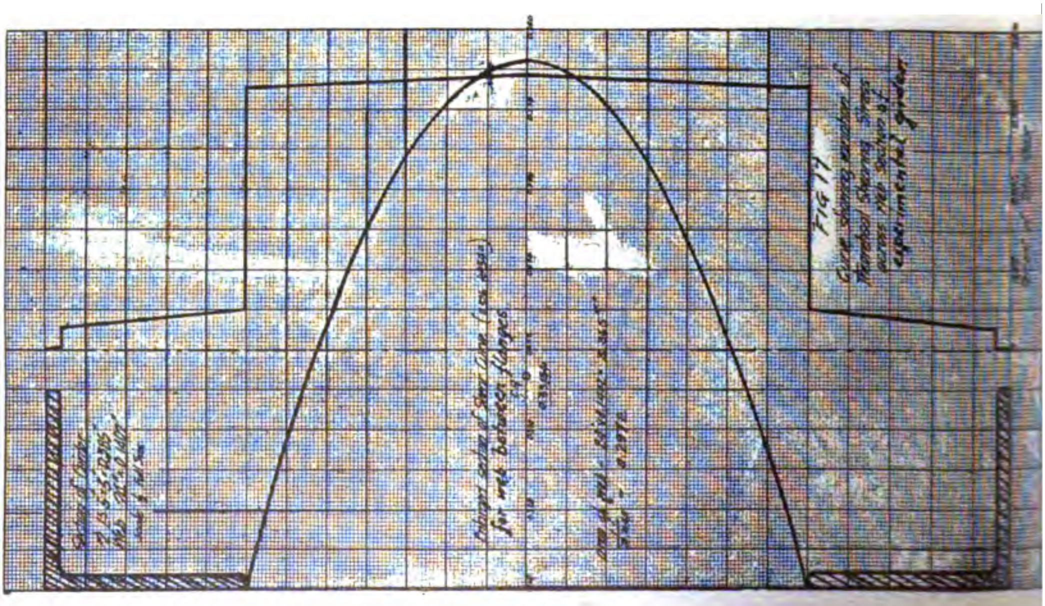


Fig. 17.

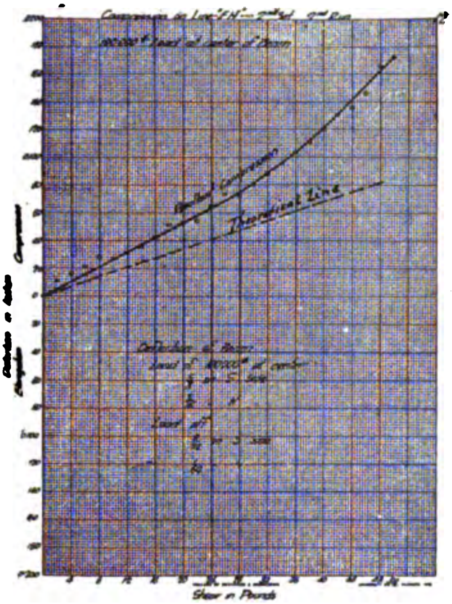


Fig. 21.

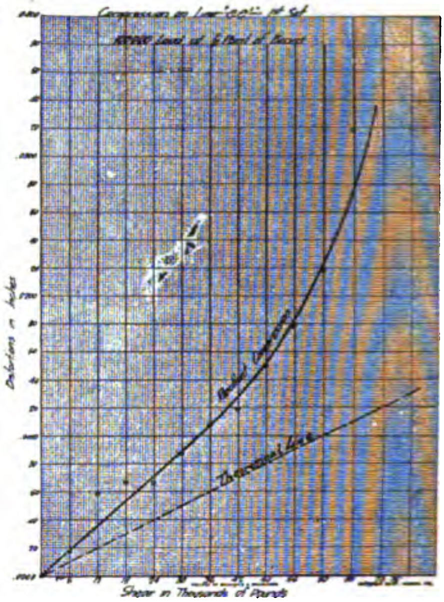


Fig. 22.

as the ultimate load $P = 4\pi^2\frac{E\,I}{l^2}$. In pounds per sq. in. this reduces to $P = \frac{1}{3}\pi^2 E\left(\frac{t}{l}\right)^2$ in which t = thickness and l = unsupported length of column. Applying this to the case in hand the ultimate buckling strength is found to be 5000 lbs. per sq. in.

In the girder tested the elastic strength is about 10,000 lbs. per sq. in., and considering the nature of the case one half of the value, or 5,000 lbs. per sq. in. may be taken as a safe value. This is equal to the ultimate strength by Euler's formula: It follows from this that if it may be assumed that the buckling strength of a web varies with $\left(\frac{t}{l}\right)^2$, as in Euler's formula, then the safe strength for any web without stiffeners would be approximately equal to the ultimate strength as determnied by Euler's formula, but not of course exceed-

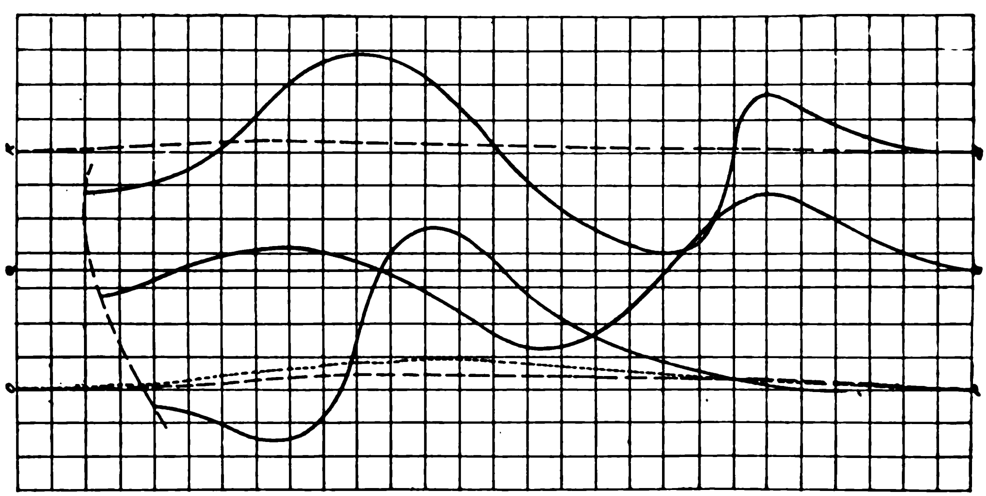


Fig. 23.

of the depth to thickness. This would give a value of 2500 lbs. per sq. inch, a value much below than here found.

As to the probable effect of stiffeners, it is to a large extent problematical. The horizontal clear space between stiffening plates, with a load at the quarter point, was 2 ft., 7 in., or 2.2 times the vertical distance. It is not likely that the spacing was close enough to materially strengthen the web. The wrinkles had already begun to develop under center load and before the stiffeners were bolted on at the quarter point. These wrinkles were practically at 45 deg. and it was these same wrinkles that developed at failure to the extent shown in the photographs. It would seem, however, from an inspection of the photographs, that a spacing of stiffeners a little closer than that used would have afforded some aid, and that a spacing equal to the vertical clear space between flanges would have aided materially. With reference to this point, it is expected that further tests will be made.

As general conclusions that may be drawn from the tests herein described, the following are offered:

1. The stresses in web plates without stiffeners, when stressed within their elastic limit, agree closely with the theoretical stresses.

2. The stresses in web plates with stiffeners, when stressed within the elastic limit, agree closely with the theoretical stresses; and as a necessary result the axial stresses in vertical stiffeners, not subjected to local loads, are practically zero.

3. The bending stresses in vertical stiffeners may be considerable.

4. The elastic limit strength of a web plate without stiffeners is, in the case here noted, about twice the ultimate strength given by Euler's column formula applied to a diagonal column element.

5. If the strength of a web plate without stiffeners may be assumed to vary as $\left(\frac{t}{1}\right)^2$, then the practice of omitting stiffeners when $\frac{t}{1}$ is more than $\frac{1}{60}$ is nearly correct.

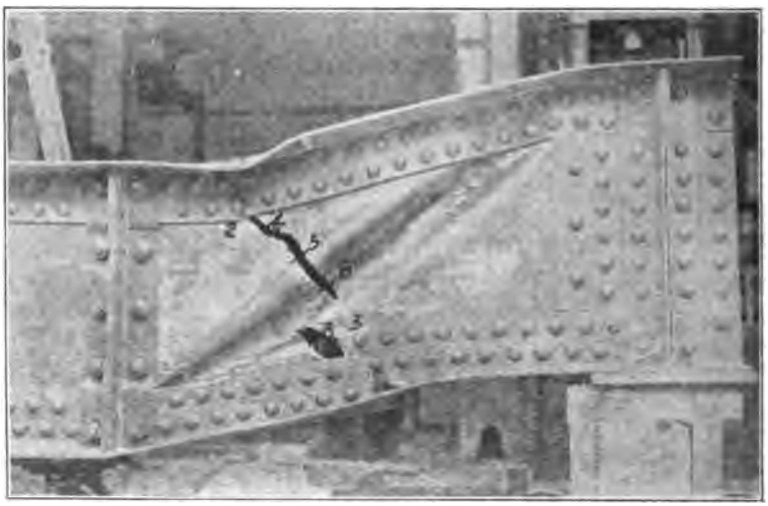


Fig. 26—Showing Progress of Final Failure.

anthracite region as a source of supply of mine timbers. The results show that peeled timber is superior in durability to unpeeled timber, and if it is peeled and seasoned for from two to four months in the woods there is an additional saving in freight and in yard room at the mines. Peeling costs from 10 to 25 cents per set. With creosote at 9 cents a gallon, mine props can be treated with a brush at a cost of 1½ cents a cubic foot, or 40 cents per set. If a timber checks, however, an opening is made through the portion protected by creosote, and decay sets in. By the use of closed cylinders a very thorough treatment is secured, but at any average cost of between $3 and $4 per set of mine timbers. A method of treatment less expensive than by the closed cylinders, and yet which secures a penetration of creosote adequate to meet most conditions, is by the open tank. By this method the cost is about $2.85 per cet.

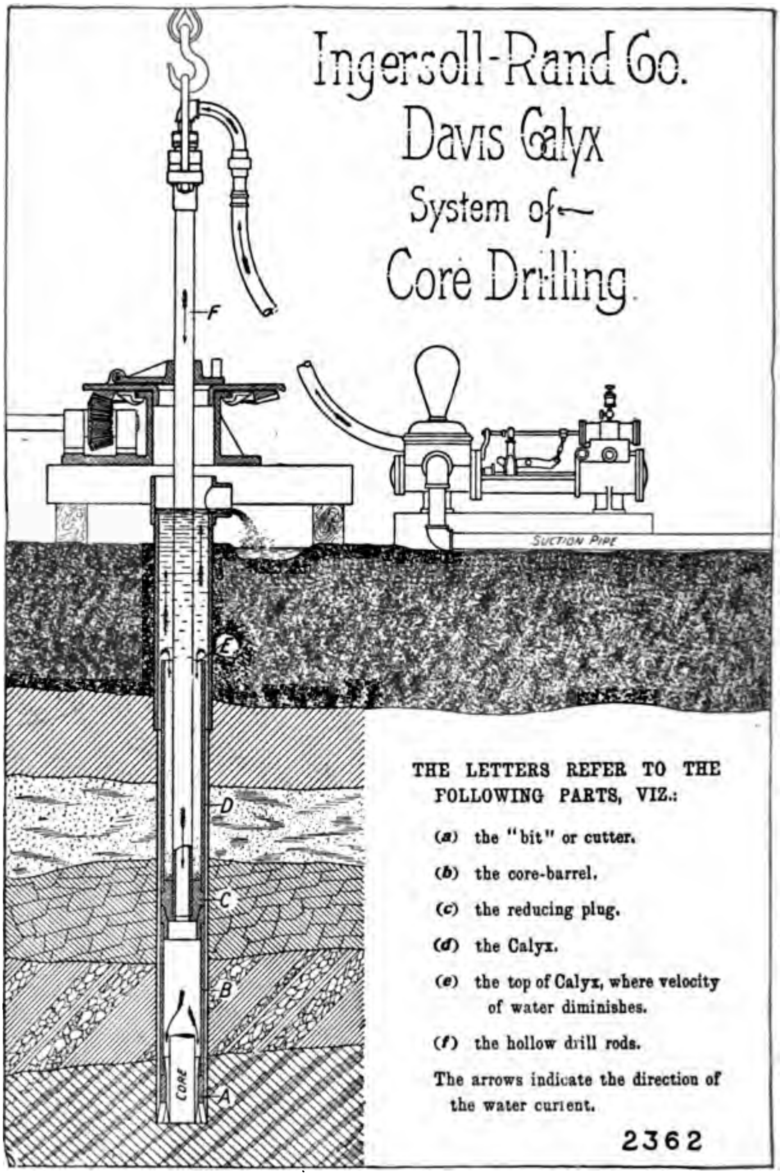
The conditions which render the life of mine timbers so short, and the experiments in peeling, seasoning, and treating with creosote, carbolineum, and zinc chlorid, are described in Circular 111 of the Forest Service, just issued. This publication will be sent upon application to the Forester, Department of Agriculture, Washington, D. C. The conditions which cause early decay of timber in anthracite mines are common in other mines, and the results of these experiments apply, in general, to the treatment of timber for underground use in all parts of the country.

*Circular 111, of U. S. Forest Service.

How to Prevent Failure in Concrete Construction.

THE many failures which have recently occurred in concrete construction emphasize the necessity for a revision of some of the current methods of design and erection, and the formulation and strict enforcement of building laws of a thoroughly searching character. As we have frequently pointed out in these columns, there is no material of construction that offers such inducements to cheap and fraudulent work on the part of the unscrupulous contractor as armored concrete. As throwing a great deal of much-needed light on this subject, we direct attention to a voluminous paper read before the Western Society of Engineers by Dr. W. Michaelis, Jr., and published in the current issue of the *Supplement*. The author of the paper deals at great length with the merits and limitations of cement and concrete and the causes of failure in concrete construction, and suggests means for the prevention of such failure. While, on the one hand, manufacturers exaggerate the advantages of cement, on the other hand the engineer and architect make unreasonable demands, and misinterpret the failures in concrete construction that so often occur. The best way to establish confidence in this modern building material would be to minimize the danger of failure by establishing proper building ordinances, which would compel the contractor to handle the material in the prescribed way, and to make proper tests of it while the building is in course of construction. The principles governing modern concrete construction are thoroughly understood, according to the author of the paper, by comparatively few; and this explains the divergence of opinion on many points pertaining to this branch of the building industry. While some engineers are careful to specify concrete of ample strength, others blame such "over-cautious" builders for making use of an excessive factor of safety. In reply to the statement frequently made by engineers that cement is not sufficiently uniform at present, and that if it could be so manufactured as to give as uniform results as steel, it would be possible for the engineer to reduce the larger factor of safety now demanded for concrete over that required for steel, the author of the paper answers that such a statement is entirely without foundation. Steel is a well-defined chemical compound rolled into the desired shape, while concrete is the sum of a number of factors. The calculation of a steel girder and that of a reinforced concrete girder can never be based on equal safety factors, no matter how much the properties of cement may be improved in the future; and it will not be improved in the future for the reason that we have arrived at the limits of its good qualities. In the opinion of Dr. Michaelis, the author of the paper, failures of concrete steel can be materially lessened, if not entirely prevented, by making it compulsory to used concrete of specified proportion of crushed stone, sand, and cement, and to use the proper kind of reinforcement in each case, and the necessary amount of it. Certain standard rules should be laid down by a board of building examiners, and certain types of reinforcing material should be excluded where they are not in their proper place. Moreover, the erection of

In the old days, any preliminary investigations must, of necessity, be made by means of prospect shafts or by churn drill holes. The expense of the former method and the unreliability of the latter, forbade any accurate and complete prospecting of a coal land area. The mistakes which resulted from this inadequate data were many and costly. For instance, the main shaft, sunk at a point chosen from surface conveniences, water supply, trackage facilities, etc., sometimes proved to enter a coal seam at the worst possible point for future development and operation. Or, the shaft was found, when too late, to have penetrated the seam at its highest point, with the result that all coal mined thereafter had to be hauled up grade to the shaft, while all water encountered drained to the entry faces instead of toward the shaft, thus increasing the cost of handling mine water. Again, the workings, after pen-



SECTIONAL VIEW OF DAVIS CALYX DRILL AS IT WOULD APPEAR COULD IT BE SEEN AT WORK UNDERGROUND.

corners of each square. The depths and strata encountered are then entered at the intersections of lines on a map representing the squares. Thereafter the element of chance is practically eliminated from the mining operation. The accuracy of the records thus obtained depends simply upon the size of the squares and upon the ability of the drill used to deliver a perfect and reliable core.

Modern construction enterprises are conducted on such an immense scale and usually involve such immense weights to be supported, that every possibility of failure due to an inadequate foundation must be avoided. This is also a preliminary to estimates of contract costs, in such instances as building and bridge pier foundations, and in tunneling. Here again the core drill offers the only solution of the problem, and the methods employed is the drilling of "soundings" over the area or along the line of the work contemplated. In this system of advance investigation, success depends again upon the economy, and in even greater degree, upon the reliability of the core drill used.

The first great advance in this line was marked by the advent of the diamond drill. The credit for this invention must be given to Leschot, who was the first to apply the diamond to the end of a rotating tube for boring purposes. The cut made by this tube was annular in form and—in theory—a solid core was left inside of the cutter, which could be broken off and drawn up at intervals, thus giving a reliable record of the various layers passed through.

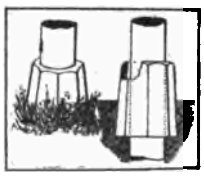
At the time of its discovery the Leschot method was inexpensive and satisfactory. Had the price of diamonds remained where it was at that time it is quite possible that the diamond drill would have been developed along mechanical lines to a state of practical and economical success. When Leschot began his investigations, large black diamonds of good quality could be had at a price of $3 per carat. But from one cause or another the price of diamonds has advanced by leaps and bounds, until in 1906 their market value is $85 to $90 per carat.

Manifestly this situation has made practically prohibitive the use of the diamond drill in large diameters. As the cost of diamonds increased, and as the greater depths reached and other circumstances created a demand for larger cores, engineers began to seek other means of making an annular cut to all depths and removing a record core. Various substances were tried to replace the diamond; but always without success. Composition bits were devised but nothing was found which would stand the wear in the harder rocks. But the experiments, diligently prosecuted, led to the discovery, almost simultaneously, of the Davis steel cutter in Australia and the method of shot drilling in America.

The Davis cutter proved to be the greatest coring tool ever used in soft, medium or moderately hard material; but it would not cut through the hardest rocks. The shot bit, on the other hand, showed remarkable penetrating qualities in very hard rocks, but was practically useless in soft materials. These two methods, therefore, seemed to be complementary to one another and it became evident that the solution of the core drilling problem lay in the successful combination of these two methods. The development of investigations along these lines, therefore, has resulted in the Davis Calyx Diamondless Drill—a very successful device for core drilling without diamonds.

We are indebted to the Ingersoll-Rand Co., 11 Broadway, New York City, for description and illustrations.

Cement Blocks Preserve Poles.



To prevent deterioration of wooden poles at the surface of the ground, where decay usually begins, a French inventor uses a pair of cement blocks. These blocks surround the pole and extend 1 foot into the ground. When locked in position cement is poured between the blocks and pole.—*Popular Mechanics.*

Roofing Paper Paint (according to R. Roedelius.)—Distilled coal tar 25 parts, distilled wood tar 18 parts, silicic acid 15 parts, magnesia 10 parts, linseed oil 6 parts, authracene oil 6 parts, iron oxide 8 parts, oxide of lead 8 parts, silicate of soda 4 parts. At a temperature of about 212 deg. F., thoroughly mixed together into a syrup-like mass. This, applied thin, changes within 12 hours into a plastic cement, of gutta-percha-like quality, that is very weather resistant.

The Industrial Magazine will be raised in price to $2.00 January 1st, 1908.

Light Concrete Roofs Are Called "Trussit."

The advantages of a reinforced concrete roof are generally recognized. Such a roof is fireproof; it has no joints or seams, and therefore is not affected by extremes of weather, and acid fumes such as frequently arise in manufacturing processes do not cause it to deteriorate. The disadvantage heretofore in connection with reinforced concrete roofs has been that such roofs, when reinforced with some metals and rods, have of necessity been very heavy. They, of course, require, as do all other forms of concrete construction, centering for their erection, entailing considerable expense.

To meet the demand for an absolutely fireproof roof which should be light, cheap and strong, there has been devised a new roofing material designated as "trussit."

It is expanded from light steel and trussed. It is erected on four-foot centers and is plastered on both sides. "Trussit" does not separate the upper and under coats of the concrete into two layers; in fact, there are no upper and under coats, except as these terms might indicate the method of application. The concrete works its way through the mesh of the "trussit," completely enveloping it and sustaining the trussed formation of the steel. The result is a light reinforced concrete slab tremendously strong in proportion to its weight. In a report of tests of four slabs reinforced with "trussit" metal and with "trussit" and cold twisted lug bars, one slab went down under a load of 464 pounds per square foot. This slab was one and three-fifths gravel concrete and was one and seven-eighths inches thick. Inasmuch as snow load on a roof is figured as 35 pounds per square foot, this indicates how light a slab is to permit a considerable saving in the steel of the roof trusses and purlins.

There are quite a variety of methods of waterproofing a "trussit" roof, and any of them that are satisfactory for use on reinforced concrete roofs work equally well with "trussit" roof.

Trussit also has been used with excellent results for the erection of solid partitions without the use of studding; that is, temporary studding is used to sustain the metal until one coat of plaster has been applied, then the studding is removed and the plastering completed. The result is a rigid wall and at the same time an extremely light one. This material comes in sheets, the stock size of which is 15½ by 96 inches, but 4, 5, 6 and 7-foot lengths may be had at a slight increase in cost.

DESIGNER & DRAFTSMAN

The Elements of Accuracy and Precision in Engineering Calculations.

ROBERT J. MCNITT.*

Those who have occasion to examine calculations and reports made by young men engaged in technical pursuits, often note with surprise the want of skill exhibited in the use of ordinary numbers. There is the man who introduces the higher mathematics into the solution of his problems, who handles his equations with academic exactness, only to misplace the decimal point or neglect numerical correctness in reduction and substitution. Another carries out arithmetical operations with unerring certainty, but fails to consider the relative values of his figures, in their effect upon the accuracy of the result. Still another measures the accuracy of his conclusions by the number of figures he laboriously places at the right of the decimal point. And how many are there who allow all calculations to rest alike, upon the number of significant figures which they are able to read on the scale of a pocket slide rule, or upon the nearest whole number selected from a four-place table of logarithms.

Technical graduates are frequently as deficient in this respect as those who have not been favored with opportunities for regular training. In fact it sometimes seems that most students are swamped by the mass of detail presented in their mathematical studies, and fail to grasp that hold upon this important discipline which renders it a most valuable accomplishment.

Into every engineering calculation enter two elements, Accuracy and Precision. The former implies a predetermined limit beyond which it may not be desirable to carry the refinements of calculation. The latter implies extreme care that this limit of accuracy be maintained precisely. To be precise in calculation is to obtain just the right result for the purpose in view: it is almost as bad to use unnecessary refinements as to carelessly throw together crude approximations. Deliberate forethought with careful and discriminating mind, is required in determining the degree of accuracy necessary; it is not merely a hurried decision to use a certain number of figures beyond the decimal sign. Recognition of the relation which the calculation bears to the problem at hand, is imperative, and an intimate knowledge of the possibilities of each of the ordinary mathematical operations is essential, in predetermining how to obtain exactly the result desired, without unnecessary effort. Having determined the degree of accuracy, and decided upon the method to be used in attaining the same, care and precision in the performance of mechanical operations will yield correct results.

To bear in mind after this manner the accuracy of one's calculations is most irksome to the beginner, like all habits of thinking, however, it becomes as it were second nature, and is done rapidly and almost unconsciously after sufficient practice.

A few problems may serve to illustrate the practical significance of this matter.

Problem 1.

An iron rod 50 feet in length, and 0.531 inch in diameter (average), is subjected to a longitudinal stress of 27500 lbs. producing an elongation of 0.281 inches with no permanent set. Find the Modulus of Elasticity.

Solution:

Considering the length of the rod and the fact that it was not machined to uniform diameter, measurements of the latter dimension would probably vary though several hundredths of an inch. Hence in the value 0.531 as given, the figure 1 is useless and the figure 3 is doubtful. Printing figures of questionable certainty in italics, we have:

*In Sibley Journal of Engineering.

Cross-sectional Area of Rod $= \frac{D_2}{4} \pi$

```
    0.53
    0.53

    15
   265
 4'0.28

  0.07
   31-7

    21
     1

  0.22  Square inches.
```

Note.—In view of the uncertainty in the quantity $\frac{D^2}{4}$ we may substitute the value 31-7 for π in place of the more complete 3.1416 . . . etc. An error of one-tenth of one per cent. in the quantity $\frac{D_2}{4}$ affects the result more than this substitution.

Insensity of Stress $= \frac{\text{Total Stress}}{\text{Cross-sectional Area}}$

```
0.22 27500 |12500  lbs. per sq. inch.
     22

     55
     44

    110
```

Relative Elongation $= \frac{\text{Elongation}}{\text{Total original length.}}$

```
   600 |0.28/0.000468
        240

         41
         36

          5
```

Modulus of Elasticity $= \frac{12500}{0.000468}$

```
0.000468 12500 |26700000 lbs per sq. in.
     936

    3140
    2808

     332
```

$$= k \frac{(p' S' + p'' S' + p' S'' + p'' S' + \ldots p' S^n + p'' S^n \text{ etc.})}{n^2}$$

Problem 2.

Given the following data, find the average indicated horsepower developed by a steam engine.

$$\frac{\text{Length of Stroke} \times \text{Mean Piston Area}}{33000} = 0.123$$

Mean Effective Pressure in Lbs. per Sq. Inch.	Corresponding Number of Strokes per Minute.
25	87
24	85
26	86
23	84

Solution:

$25 \times 87 = 2175$
$24 \times 85 = 2040$
$26 \times 86 = 2236$
$23 \times 84 = 1932$

```
   4'8383

    2095
   0.123

      63
     419
    2095

    257.  Average I. H. P.
```

A shorter method sometimes used by careless computers may give results quite close to those obtained as above:

Average mean effective pressure $= 24$.

Average No. Strokes per minute $= 85$.

Average I. H. P. $= 24 \times 0.123 \times 85. = 257$.

Although both results are alike, the latter method is inherently wrong and may lead to serious error, as may be shown by considering the general case.

Let p', p'', . . . p^n represent Mean Effective Pressures.

Let $k = \frac{\text{Lgth. of Str.} \times \text{mean pis. area}}{33000}$

Let S', S'', . . . S^n. represent the number of strokes per minute. By the shorter but more erroneous method:

$$\text{Av. I.H.P.} = \frac{p' + p'' + \ldots p^n}{n} \; k \; \frac{S' + S'' + \ldots S^n}{n}$$

Multiplying out:

Average I. H. P.

The true average I.H.P. is, however, equal to:

$$k\frac{(p'S'+p''S''+\ldots p^n S^n)}{n}$$

In general these two expressions may be reduced to identities only upon the condition that $p'=p''=p^n$, etc. or $S'=S''=S^n$ etc. The more closely these conditions are fulfilled, the more nearly a perfect identity. The numerical problem above does not meet these requiremnts. The fact that results by both methods are equal is due to a mere chance combination of figures, which might not occur again in hundreds of trials.

Problem 3:

Find weight of water required to dilute one pound of Sulfuric Acid from density 60 degrees Be. to 50 degrees Be.

Solution:

From Lunge's Tables (see any chemical hand-book) we find

60 Degree Acid contains 78.04% pure H_2SO_4.
50 Degree Acid contains 62.53% pure H_2SO_4.

$$\text{weight of water required} = \frac{78.04-62.53}{62.53} =$$

0.248 Lbs.

For certain calculations involving other parts of these tables, it is sufficiently near the truth to assume that the weight of water required is approximately equal to the difference between the percentages of pure H_2SO_4 contained in the acids under consideration. One is not warranted in applying this "short-cut" however until he has found that the error introduced will not affect the usefulness of his results. In the problem above, this error would be about 37% which for most work is not permissible.

Owing to the want of minor elements of data, it is often impossible to solve a problem rationally or with mathematical rigor and completeness. One who computes intelligently will generally succeed in obtaining results in such cases quickly and satisfactorily, by working back to known data from assumed or trial values for the unknowns. Such problems are avoided in despair by both the mathematical prig, and the rule of thumb man.

Great disparity between the values of quantities frequently offers opportunity for saving labor and time in the hands of a discriminating computer. Thus if x, y, and z, represent values small in comparison with 1, the following approximations may be used:

$(1+x)$ $(1+y)$ equals approximately $1+x+y$.
$(1+x)$ $(1-y)$ equals approximately $1+x-y$.
neglecting the product (xy).

$(1+x)^n$ equals approximately $1+nx$.

$\frac{1}{1+x}$ equals approx. $1-x$, and $\frac{1}{1-x}$ equals approx. $1+x$ since 1 equals approximately $(1+x)$ $(1-x)$ which is equivalent to 1^2-x^2.

Log. $(1+x)$	equals	approximately	x.
Sin. x	"	"	x.
Tan. x	"	"	x.
Cos. x	"	"	1.

From the standpoint of pure mathematics all numbers are treated abstractly, and when substituted properly in rigorously proven equations must yield results of absolute exactness.

The Engineer, however, can not make his assumptions at will, he must base them upon the laws of nature and economic conditions of society, keeping well in view, limitations in the arts of measurement and manufacture. His Quantities are not commensurable and the numbers which he employs may not be complete. Evidently he must give the same careful attention to the limits of his methods of calculations which he is compelled to give to other factors in his problems.

The value of forming this habit of mind becomes manifoldly greater as the amount of routine calculation increases. Thus in drafting rooms or estimating and computing departments, where similar calculations are made day after day, enormous saving in time and labor may be effected by the intelligent use of approximations.

Concrete is now being employed for paving purposes. This material promises smoothness, cleanliness of surface and durability. A foundation of cinders to the depth of ten inches is first made and permitted to pack well for a week. Then the concrete curbing is made in the usual manner. Finally the concrete is mixed and thrown into place, considerably higher in the center and sloping to either gutter. Immediately before the concrete hardens it is marked off with an instrument to resemble a pavement laid with brick. This method will insure a firm footing for draft horses in winter.

very effective in closing the pin-holes, which are generally characteristic of malleable fittings when used at high pressures.

A feature of interest that developed in these tests was the stretching of the metal in the fittings as the pressure increased. Careful measurement of the body of the tees with calipers before and after the application of pressure showed that the diameter had increased from ⅛ to ¼ of an inch. This stretch caused excessive leakage in the threads of the fittings at the higher pressures and made considerable trouble and annoyance in conducting the tests. On this account it was found advisable to raise the pressure, in making the tests, as quickly as possible, as in so doing the fittings were fractured before they had had time to stretch and leak to any great extent. This sudden application of pressure no doubt had a tendency to produce failure of the fittings at lower pressures than if the pressure had been applied gradually without shock. This difficulty could have been avoided by screwing the plugs farther into the tees when the pressure had reached a point slightly below that at which the fittings were expected to fail. Such a procedure would, however, be accompanied with danger, as any air entrained in the tee might cause a disastrous accident with probable loss of life in case of premature bursting of a fitting.

The accompanying sketch shows characteristic fractures of the fittings tested. Most of the tees failed as in Test No. 5, cracking through the beads at one end and the side outlet of the fitting. No pieces of metal were entirely separated from the tees when they failed, as was the case with the cast-iron fittings. The malleable-iron fitting, being tough and slightly elastic, was simply torn apart while the cast-iron fitting, being more brittle, broke in many cases into separate and distinct pieces. These tests show plainly the superiority of malleable over cast iron for use in the manufacture of pipe fittings of small size.—*Power.*

The greater safety of alcohol as compared with gasoline for commercial uses is due to the fact that it will not ignite from pure radiated heat as gasoline does; that water will extinguish burning alcohol, while it will only spread a fire of gasoline, and that the flame of burning alcohol radiates very little heat, while that of gasoline radiates heat very rapidly.

Literature of Structural Steel Designing.

JUST at present, the field of structural designing so far as steel work is concerned, offers lucrative positions, and there is no good reason why this field should be overlooked by the strictly mechanical designer. With comparatively little labor upon his part, the elements of this work can easily be mastered.

In fact, so general has mechanical designing become that it already overlaps to some extent the chasm separating the two fields and naturally it is important that he should absorb sufficient knowledge of structural steel work to meet his wants and the demand. The designing of skeleton steel buildings, plate girders for traveling and jib cranes, steel framework for engine foundations and pipe lines, and towers for water tanks come well within the lines of the mechanical designer.

While it is considered the province of the bridge engineer to determine the stresses due to locomotive loads, the determining of stresses due to static and wind loads comes within the province of the mechanical engineer, and checking the various members and joints of structural steel work, the mechanical designer is the man who can "deliver the goods" One of the slickest structural steel designers I ever saw is a mechanical designer and followed mechanical designing quite a number of years before he went into structural work.

During the past four years, the writer has done considerable structural steel work, both in the field and office, and has had opportunity to learn what is current along theoretical and practical lines, and has found the work profitable and interesting.

As a nucleus, start with the small handbook gotten out by the International Correspondence Schools, bearing the title "Building Trades Pocketbook," Thompson's "Bridge and Structural Design" and Howe's "Design of Simple Roof Trusses in Wood and Steel." These will give an insight along what will be required.

The manufacturers of structural steel issue excellent hand-books, which contain a vast deal of information and may be obtained from these companies at prices ranging from $1 to $2 per copy, and they are worth this money several times over. The ones with which I am familiar are "Cambria Steel" (Cambria Steel Company), "Standard Steel Construc-

is to render. All these are vital to the fuel economy and reliability of the engine. The proportion of the combustion chamber area to the volume of gas at the time of greatest pressure must be a minimum in order that the maximum work may be obtained from the expanding gas. For this reason all pockets must be avoided.

All valves must be large enough to allow the gas to enter and exhaust freely.

Inlet and exhaust passages must be of proper size, and have smooth curves so the flow of gas shall not be choked in any way.

The clearance must be as low as possible as this affects the economy of the engine.

The crank and connecting rod must have strength to withstand the severe strain put upon them. The bearings must be large and well proportioned.

Not only are complete assembled drawings necessary, but every part must be carefully drawn in enough positions to give the workmen a clear idea of the piece. These drawings must be carefully and fully dimensioned.

When the manufacturer has these drawings he is in a position to plan for the manufacturing end of his business and not before.

When all these things are considered it is plainly seen that to build good gas engines without first making careful and complete drawings is almost, if not altogether, impossible.

The success and efficiency of a gas engine depend almost entirely upon the designer. Thus it is to the manufacturer's interest to obtain the best brains that his purse will permit.

Not only the reliability and efficiency of the engine depend upon the designer, but also the cost of construction. The designer can make or break his employer by the engine he furnishes, because the customer will pay only so much for a given sized engine and this one must be sold for that amount with a good margin of profit. Therefore the designer must not only have inventive ability, but must be familiar with every part of the production end of the business for he is a vital factor in the cost of production of the engine. Thus we see that the best man is the cheapest man for the manufacturer, and is one of the foremost captains in his army of men.

E. B. SMITH, in "Gas Power."

(This Department will be discontinued in the January issue and the matter merged into the previous department, "The Engineer and Constructor.")

A Blasting Adventure.

BY VOX POPULI.

At a well known works it was the practice to blast all the big pieces of scrap steel, such as armor plate ends, big ingots, shaft forging, etc., with dynamite to make them small enough for the furnaces.

These pieces were allowed to accumulate for some time and then "Blaster Jack," an expert, was called in. In order to prevent pieces from flying about, a room had been dug in the ground lined with old pieces of armor plate and covered with large pieces of 6-inch armor plate for a roof.

Now some of the boys used to steal off to this room for a quiet smoke and one day a couple of "green" laborers noticed them crawl out of the hole in the ground so when all was clear these two laborers went and investigated and were delighted with the nice shelter they found. On the floor were two big ingots, and between one of these and the wall they lay down and were soon asleep. Now it happened that "Blaster Jack" had been busy all that morning and had got the other ingot all drilled ready for breaking, and while the "green" ones were peacefully sleeping he came along and put the dynamite sticks in the holes, connected the electric fuse, got outside and at the opportune moment pushed the button. There was a deep dull roar and suddenly "Blaster Jack" was paralyzed to see two figures bob up through the hole, scamper down the yard as if the very devil was after them, but he wasn't so astonished as the machine shop gang was, when two laborers flew in and tripped over the steam pipe Will was getting the tee off. This scared them worse and both gave a terrific yell and crawled under the bench. After a time the boys got them out, persuaded them to talk one at a time and heard the story. Neither was hurt but they were scared, and scared good and plenty. The foreman gave them a lecture on dadging and sent them home for the rest of the day to get over their blasting adventure.

Brussels Wharf Rats.

Brussels is enlarging its port and in a few years' time large steam boats will be able to reach the Belgian capital. Its canals have been deepened, and an important water traffic is being carried on. Coal from the industrial districts of Mons and Charleroi is brought in big barges, the cheapest method of transportation. Sand, tiles, bricks, are daily being floated in to build the new part of Greater Brussels, which is fast springing up. Cheap transportation is the motto in this country, where long working-hours and small wages reign supreme. Cheap labor must be used, no machinery, no cranes. Barges are unloaded by porters, and it is a curious sight for an American familiarized with modern working-methods to see these tall, strongly built Flemish porters unloading sand, coal, bricks and tiles. They work hard, and both bosses and workers are strongly opposed to up-to-date methods of unloading. Time is no object to them, and they stick to old traditions. They earn from six to eight cents in American money, per hour.—From the *Technical World*.

Technical Education in Dresden, Germany.

THERE is no question but that the mechanical and electrical equipment at the Dresden Technical Institution is equal to that of any school of its kind in Europe. The Kgl. Sachsischen Techmischen Hochschule cost nearly two million marks and has a floor area of over a million square feet (121,307 square meters). As noted in the accompanying illustration and drawings it includes five principal buildings, consisting of an Administration Building; two Mechanical Laboratories, A and B, in one building; a Technical Research Laboratory; an Electrical Power Station, and the Electro-Technical Institute. Prof. Wilhelm Kubler has charge of the electrical equipment. He is also Editor of "The Elektniche Bahnsn und Betriel," published at Munchen, Germany.

The Mechanical Laboratories A and B are located in a well equipped building with tubular and water tube boilers, steam pumps, condensers, hydraulic turbines and vertical as well as horizontal steam engines, also steam turbines and tower with steam turbine ventilator.

There is a 150 horse power triple expansion horizontal engine installed in Maschinenlaboratorium A, constructed by C. E. Rost & Co. of Dresden, also four other engines from 25 horse power to 200 horse power in capacity, as well as a De Laval steam turbine of 30 horse power. The horizontal engine is so arranged as to be operated as a tandem compound engine if desired, a twin compound, or a simple engine, with or without condensers and with or without superheated steam for various experimental work.

In the boiler room are several type of steam generators, including a water tube boiler with superheater of E. Leinhas, of Freiberg I. S. Germany, a Lewicki boiler of H. Pauckesch, of Landsberg, without superheater and a tubular boiler with superheater, built by R. Wolf at the works at Magdeburg-Buckau. The usual auxiliary apparatus is also provided in the boiler room with the latest equipment for complete boiler tests. A connecting tunnel with heating pipes provides a subway from powerhouse heating all the buildings.

In the Hydraulic Laboratory, there is a high pressure turbine of Amme, Giesecke & Konegen, a Jonval-Turbine with a speed of 110 revolutions per minute and a Francis-Swain Turbine with a speed of 131 revolutions per minute, together with a most complete installation of electrically operated centrifugal pumps for hydraulic experiments.

The gas engine and gas producer apparatus is installed in the Maschinenlaboratorium B, and includes a 70 horse power gas engine of Gasmotorenfabrik Deutz for illuminating gas and generator gas; also an 8 horse power Kreuzkopf motor also built at Deutz, together with an 8 horse power engine of the internal combustion type built by Gebruder Korting for benzine, alcohol, petroleum and illuminating gas, special provision being made for burning these various fuels.

A vertical gasoline engine of 8 horse power of the Dion Bouton type is also in service operating at a speed of [illegible] revolutions per minute together with a number of other gas engines of smaller capacity.

A complete gas generating plant has also been provided and outside of the building a

Dresden Technical School

[illegible]

[illegible]

[illegible]

[illegible]

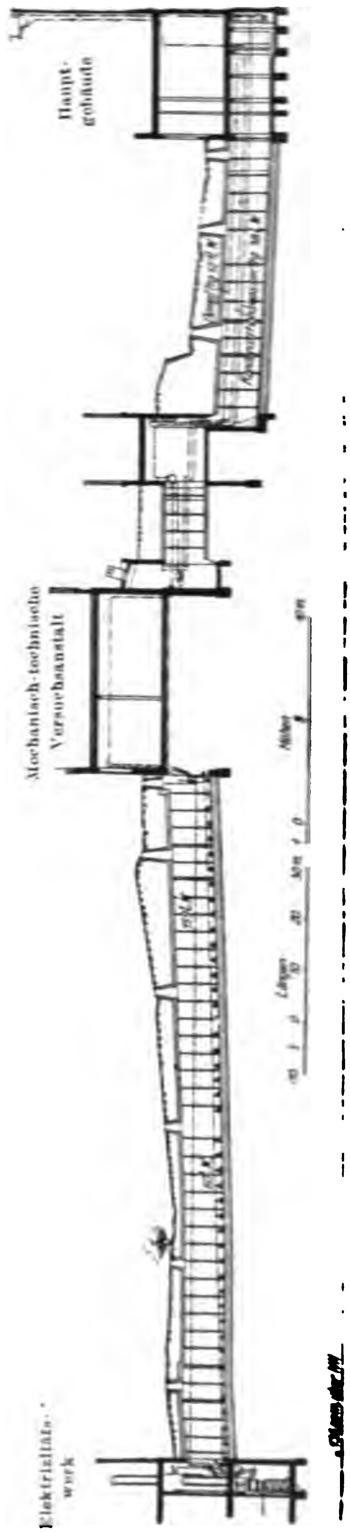
gas-meter has been installed with a condenser on top of the building. Special tests are made ...ing apparatus, a most complete ammonia plant being provided with numerous types of compressors, electrically driven and engine driven.

In the main building of the Dresden Technical school is located the main lecture room on mechanics, hoisting machinery and transportation machinery, which is under the direction of Professor M. Buhle, to whom the writer is indebted for the accompanying illustrations, drawings and data. The drafting rooms are also located in this building for this line of study, as well as the extensive collection of mechanical devices of every description, constructed of metal and wood.

In this building is also located the dynamometric station, a complete electric elevator and hoisting installation for testing work of the Klein system furnished by A. Kuhnscherf, Jr., of Dresden. The machine shops and wood working shops are thoroughly equipped with the latest electrically operated machine tools, including lathes, planers, drills and boring machines, also cranes, electrically driven wood working machines.

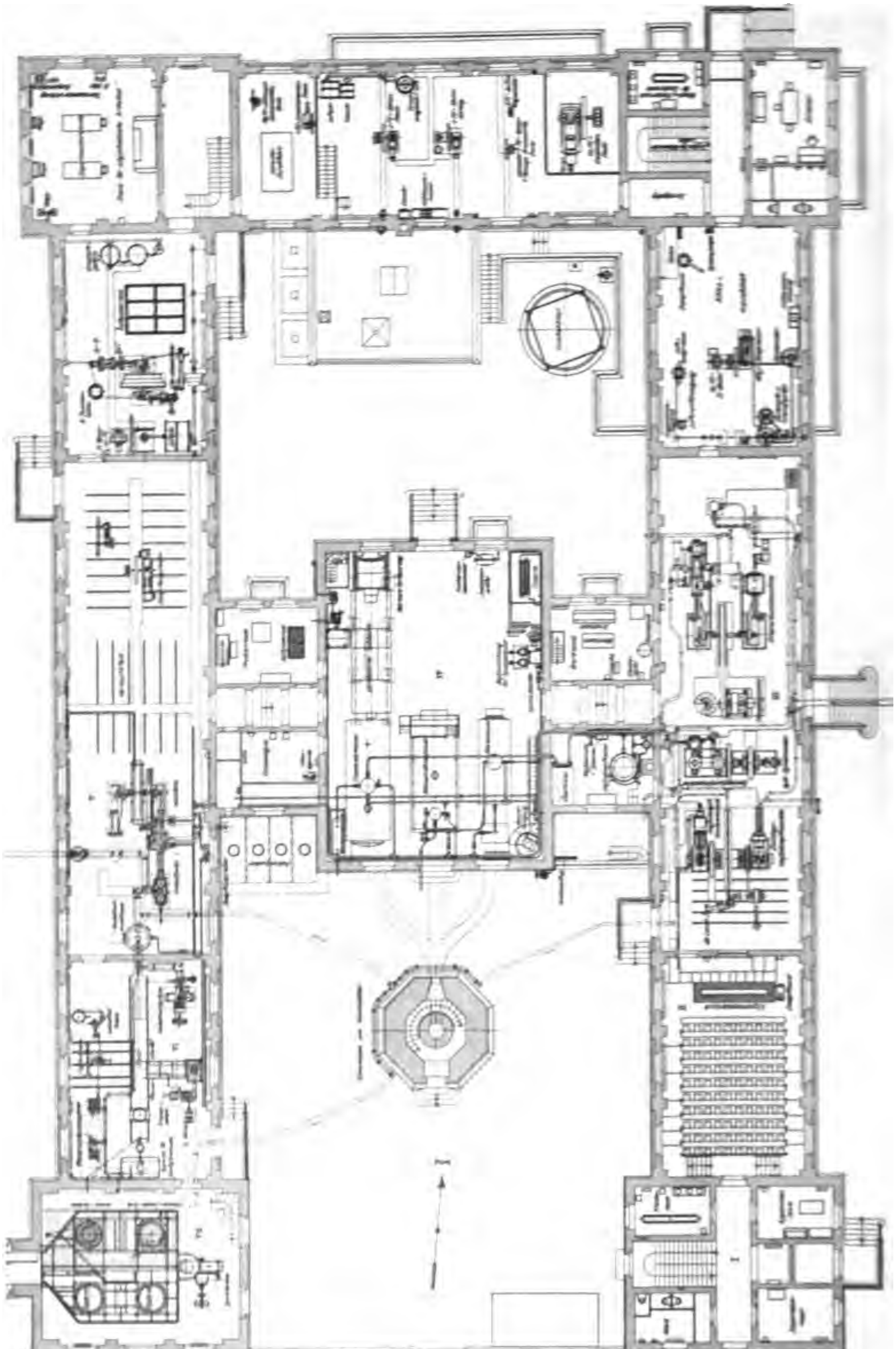
In the mechanical research laboratory there are testing machines for materials of construction, hydraulic presses, accumulators and electrically driven compressors for supplying oil under pressure as well as water under pressure to the accumulator plant. Pro-

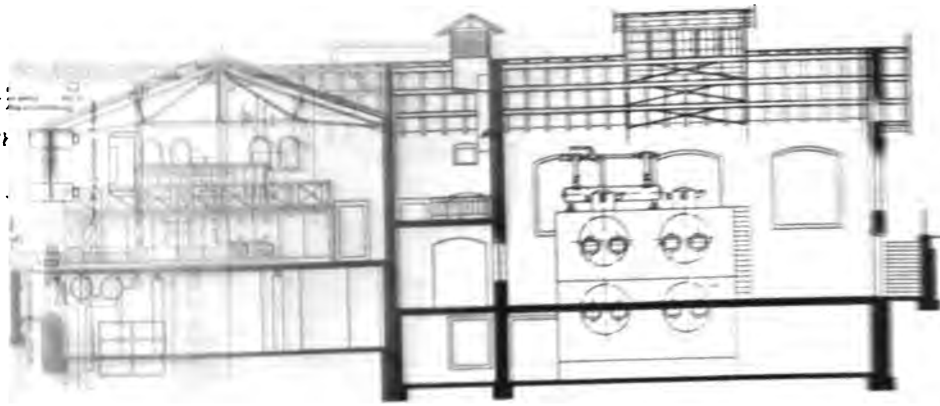
Dresden Subway or Tunnel.

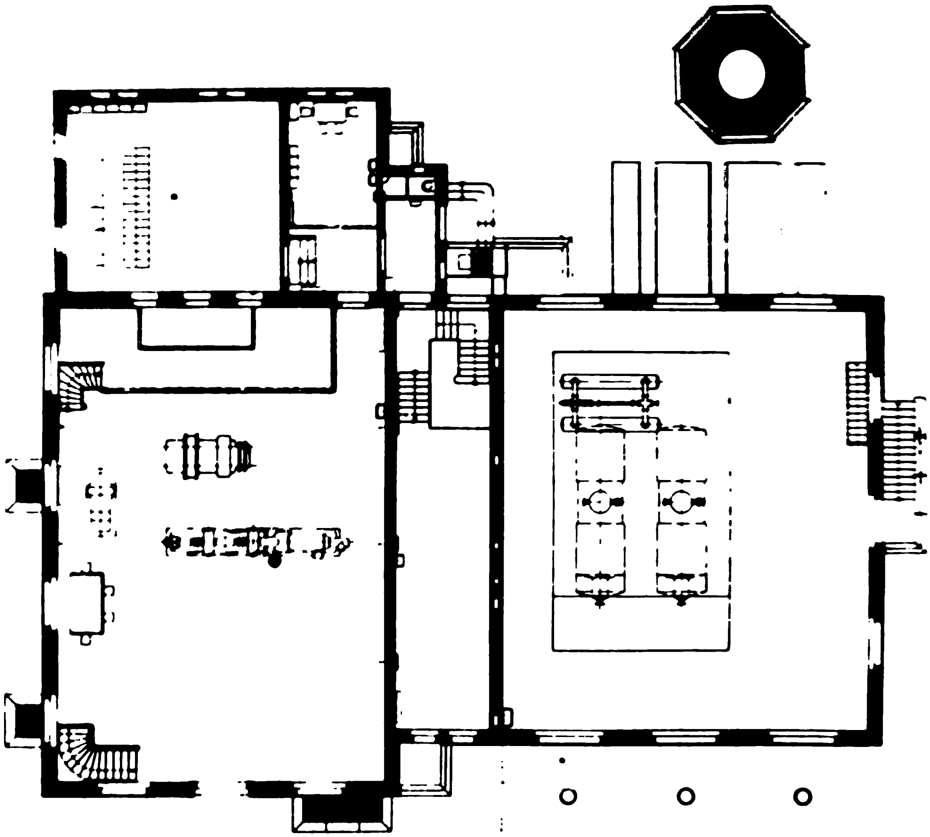


The Railway [illegible]

The Railway [illegible]







visions have been made for testing enormous iron beams, the testing of cement and stone as well as structures built of those materials. Without doubt this German technical institution is one of the finest in the world, for it is claimed that while others may be larger, and more expensively equipped, the work done at Dresden is held to be excelled nowhere.

THE ELECTRO-TECHNICAL EQUIPMENT.

Without doubt the Electro-Technica' Equipment of the Kgl. Sachsischen Technischen Hochschule in Dresden ranks as high as that of any similar institution in the world. This technical college was founded in 1828 and has always been recognized as one of the leading polytechnical schools in Germany.

Testing Laboratory.

The accompanying illustrations and drawings show a portion of the electrical and mechanical equipment and the arrangement of the laboratories, power house and Electro-technical Institute, the latter being one of the principal buildings and devoted exclusively to electrical work.

The electric light and power station is equipped with two steam turbo generators which supply current to the various buildings for light and power service. The Maschinen-laboratorium A, taking 100 kilowatts, the Maschinenlaboratorium B, taking 50 kilowatts and the Elektrotechnischen Institut 150 kilowatts, while the mechanical research laboratories and main building take over 100 kilowatts, or a total of about 400 kilowatts.

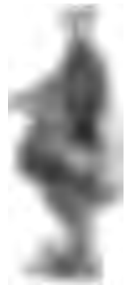
The Brown-Boveri Parsons turbine operates at a speed of [illegible] revolutions per minute and is supplied with steam at a pressure of 7.5 atmospheres and a temperature of 300 degrees, and directs two generators of [illegible] horse power capacity each on the same shaft.

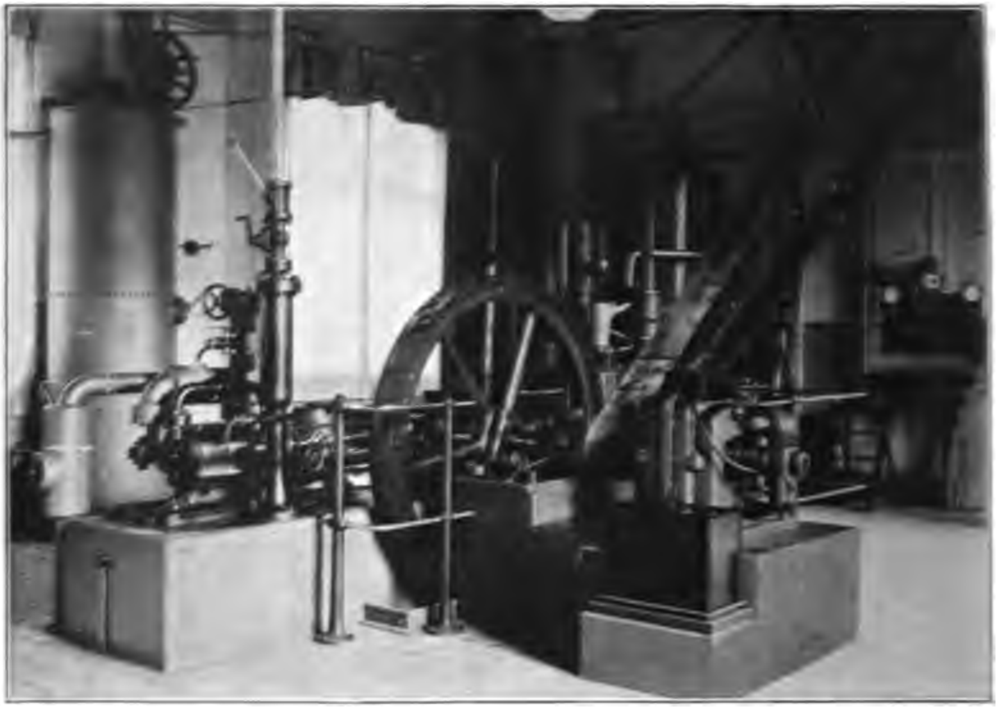
The other steam turbine unit consists of a Laval turbine direct connected to Siemens-Schuckert double dynamos, the armatures of which have [illegible] revolutions per minute while the steam turbine wheels operate at a speed of 13,000 revolutions per minute, the steam pressure being 7.5 atmospheres and the same temperature 300 degrees. The latter unit is provided with slip rings so that an alternating current may be obtained as well as a direct current, if desired.

A storage battery installation has been provided consisting of two groups of 60 cells each at the Electro-technical institute, and this accumulator plant together with the steam turbo generators and reserve units are capable of supplying 500 horse power or about 370 kilowatts or a current of 840 amperes on the three wire system of 2 x 220 volts.

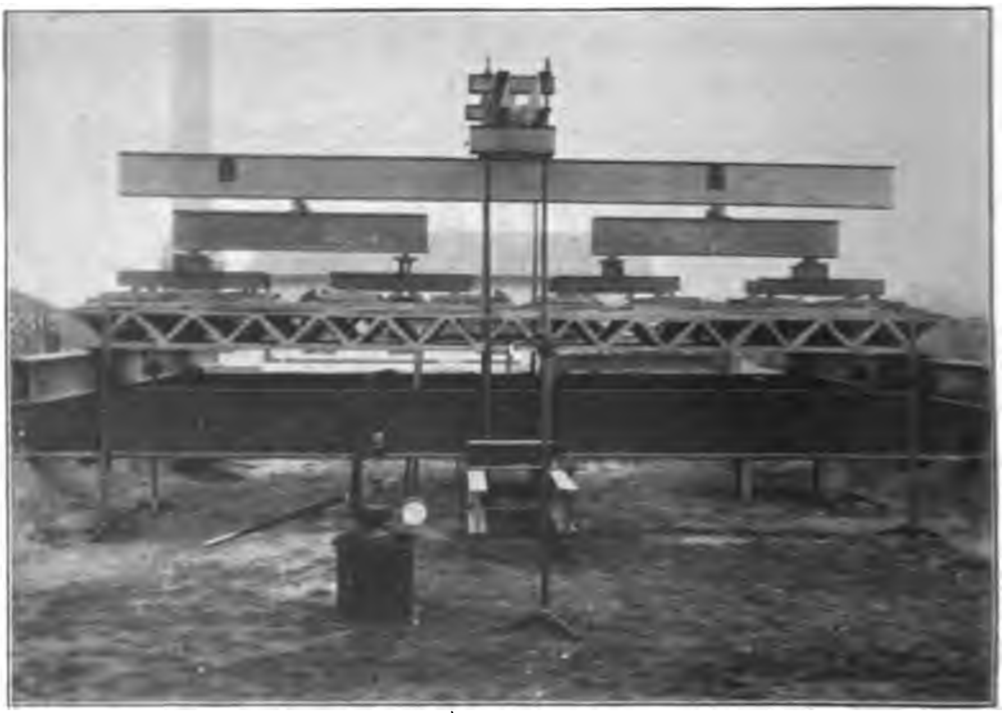
The steam turbines are supplied with steam from two boilers of 130 square meters heating surface each, installed by the Maschinenfabrik Germania of Chemnitz. The superheated steam is supplied by superheaters of the Zobler Dresden type of 35 square meters heating surface each.

The electro-technical institute is provided with cable testing rooms, high and low tension laboratories, electro chemical and battery research departments, and direct and alternating current equipments. In the experimental





Electrical and Refrigerating Laboratory.



Testing strength of materials of construction at Dresden Laboratory.

[illegible] are [illegible] motor generator groups, [illegible] of these sets consisting of three machines [illegible] of 50 kilowatts and one set being a unit [illegible] of 10 kilowatts capacity.

[illegible] set includes a two phase and three phase machine of 110 volts or 220 volts at a frequency of 50 periods per second, built at Frankfurt, a/M by the Elektricitats-Actien-Gesellschaft, formerly W. Lahmeyer & Co., also operated by a 50 horse power motor. The third group consists of a 15 horse power motor driving a three phase alternator and a direct current machine at a speed varying from 650 to 1,900 revolutions per minute, the continuous current machine supplying a current of a pressure varying from 20 volts to 70 volts. The current is conducted from these motor generator sets by underground cables to the various switchboards, the direct current switchboard equipment being provided by Voigt & Haeffner of Frankfurt a M and the alternating current instruments and switches by the Elektricitats-Actien-Gesellschaft, formerly Poge of Chemnitz.

A number of storage battery installations are in service, including those of Hagen, Geln-

One set includes a direct current machine of at Berlin by the Bergmann Flektricitats Werken driven by a 50 horse power motor. hausen and the Akkumulatorenfabrik A. G. of Berlin, the latter storage battery plant having charge. The electro-technical institute is also a capacity of 100 amperes for three hours' dis-110 volts and another of 500 volts constructed provided with an excellent telephone, telegraph and signal laboratory, equipped with the latest apparatus of foreign and American construction.—F. C. P.

The Harrell Pneumatic Pump Co., Chicago, Ill., have issued several bulletins on their pneumatic pumps and return air systems.

The University of Illinois bulletin 1907 made announcement of Engineering Experiment Station Research Fellowships in the College of Engineering.

The Erie Pump & Engine Co., Erie, Pa., have issued circular "DA" and "DC" on centrifugal pumping machinery, showing direct connected outfits.

The Cleveland Crane & Car Co., Wickliffe, O., issued bulletin "D" descriptive of their hand and electric [illegible] post and car cranes, [illegible] for machine shops, foundries, and out [illegible]

[illegible] Iron Works Company, Cleve-[illegible] [illegible] size.

The Marion Incline Heater & Filter Co., Marion, O., have issued catalog G-1, descriptive of several types of feed-water heaters, heaters and receivers, oil separators and steam traps.

The Ajax Iron Works at Corry, Pa., have issued a revised list of the John Brennan & Co.'s boilers. The former company are manufacturers of the Ajax gas and gasoline engines and center crank stationery engines.

Messrs. J. H. Wagenhorst & Co., manufacturers of electric blue print machines, Youngstown, Ohio, have issued a catalog descriptive of their machines for making blue prints by artificial light. These machines are made to take prints up to 42 x 72.

The Triumph Steam Engine Indicators and [illegible] are illustrated in a book issued by the [illegible] Indicator Co., Corry, Pa. The company is now manufacturing appliances [illegible] made by The Buffalo Indicator Co., [illegible] and the Engineering P[illegible] Co., [illegible] N. Y., and include indicators, [illegible] meters, indicator [illegible]

Machine Shop Philosophy.

Some of the great Captains of Industry are only pirates in disguise.

Make every blow count except the one aimed at your fellow man.

A stitch in time often answers for an excuse for being late in the morning.

Work for the firm's interest and sooner or later the firm's interest will be your own.

Don't consider the boss your enemy, for if you do he can never become the ideal boss.

The Jack of all Trades has had his day. If a man is good at one thing nowadays he is a prize.

Don't poke fun at the micrometer man just because you are a "two-foot-rule" machinist and have always got along all right.

Don't count how many motions you have to go through; just see how quickly and easily you can make them and get your work out of the way.—*Joe Cone.*

Chronology of Inventions.

The torpedo was first made in 1777.

Billiards were invented in France in 1471.

The first horse railroad was built in 1826.

The folding envelope was first used in 1839.

Brandy was first made in France, in 1310.

Bombshells were first made in Holland, in 1495.

Iron pavements were first laid in London in 1817.

Coal oil was first used as an illuminant in 1826.

Barometers were first made by Torricelli in 1643.

The first almanac was printed in Hungary in 1470.

Roller skates were invented by Plympton in 1863.

The first American paper money was made in 1740.

The first plaster cast was made by Verochio in 1470.

Alcohol was discovered in the thirteenth century.

Advertisements first appeared in newspapers in 1652.

Covered carriages were first used in England in 1580.

The first iron wire was drawn at Nuremburg in 1351.

Shorthand writing was the invention of Pitman in 1837.

Stem winding watches were the invention of Noel, in 1851.

The first pipe organ was made by Archimedes in 220 B. C.

The first dictionary was made by the Chinese scholars in 1109 B. C.

In addition to appointing a special traveling agent to look after the freight yard and station service, the B. & O. has appointed a committee to devise some plan to provide for a more rapid movement of freight cars belonging to "foreign" lines and handled by that company. The committee will report to the general manager.

Effective July 1, the government will reduce the Pennsylvania's compensation for the transportation of mails between Pittsburg and Philadelphia $173,000. Other reductions aggregating $500,000 are proposed. Last year the railroad company was paid nearly $2,000,000 for mail service and rental of postal cars.

In order to establish a connection with the line which the New York Central is building between Newcastle and Franklin, the Western Allegheny, at a cost of $1,500,000 is to be extended from East Brady to Leesburg, Pa., thirty miles. Several long bridges will be built. The cost of construction will be about $50,000 a mile.

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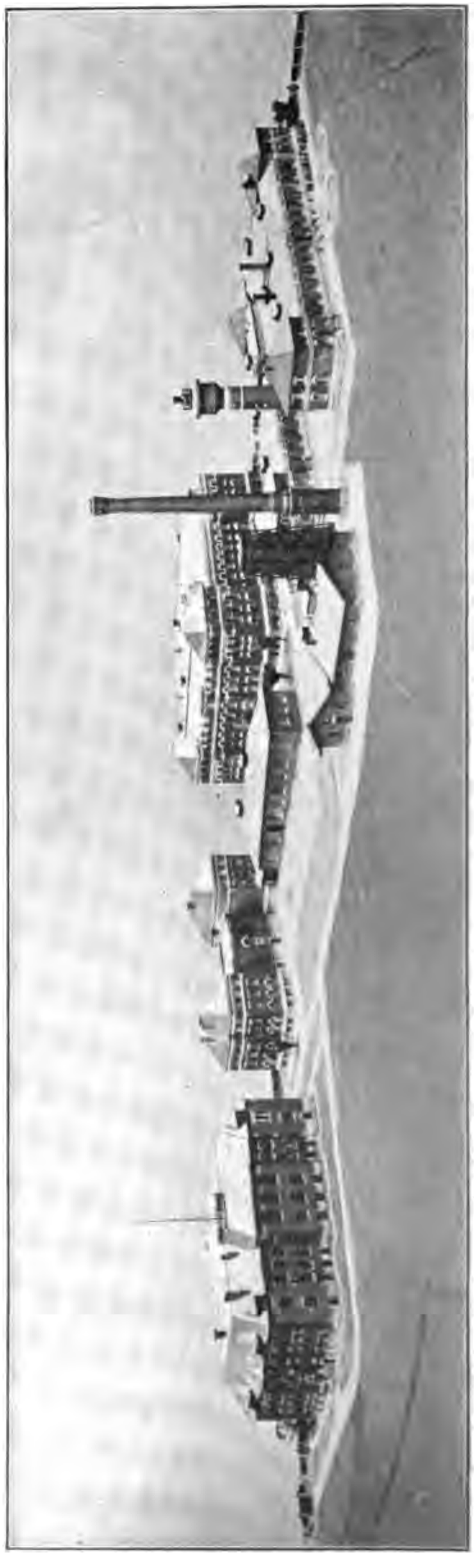


Dresden Technical School.

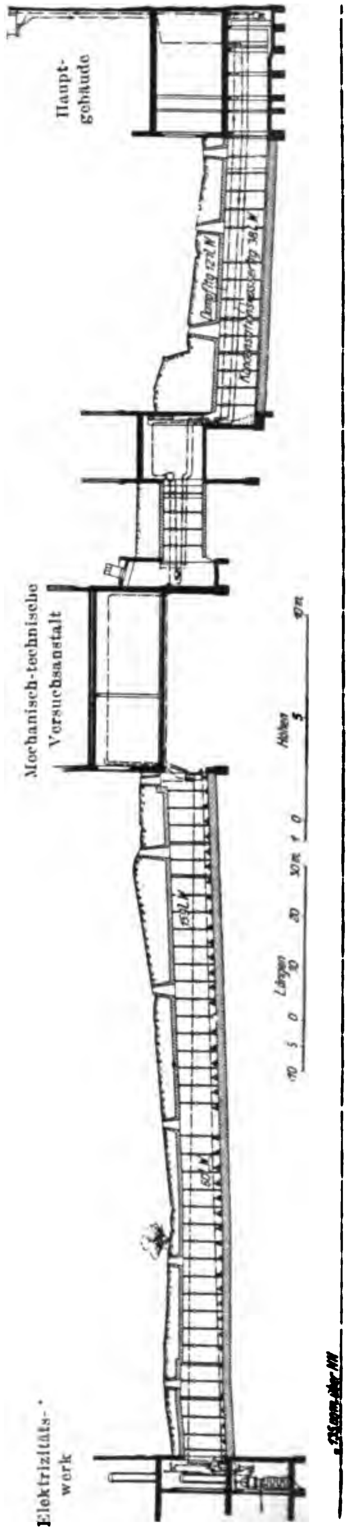
gasometer has been installed with a condenser on top of the building. Special tests are made ing apparatus, a most complete ammonia plant being provided with numerous types of compressors, electrically driven and engine driven.

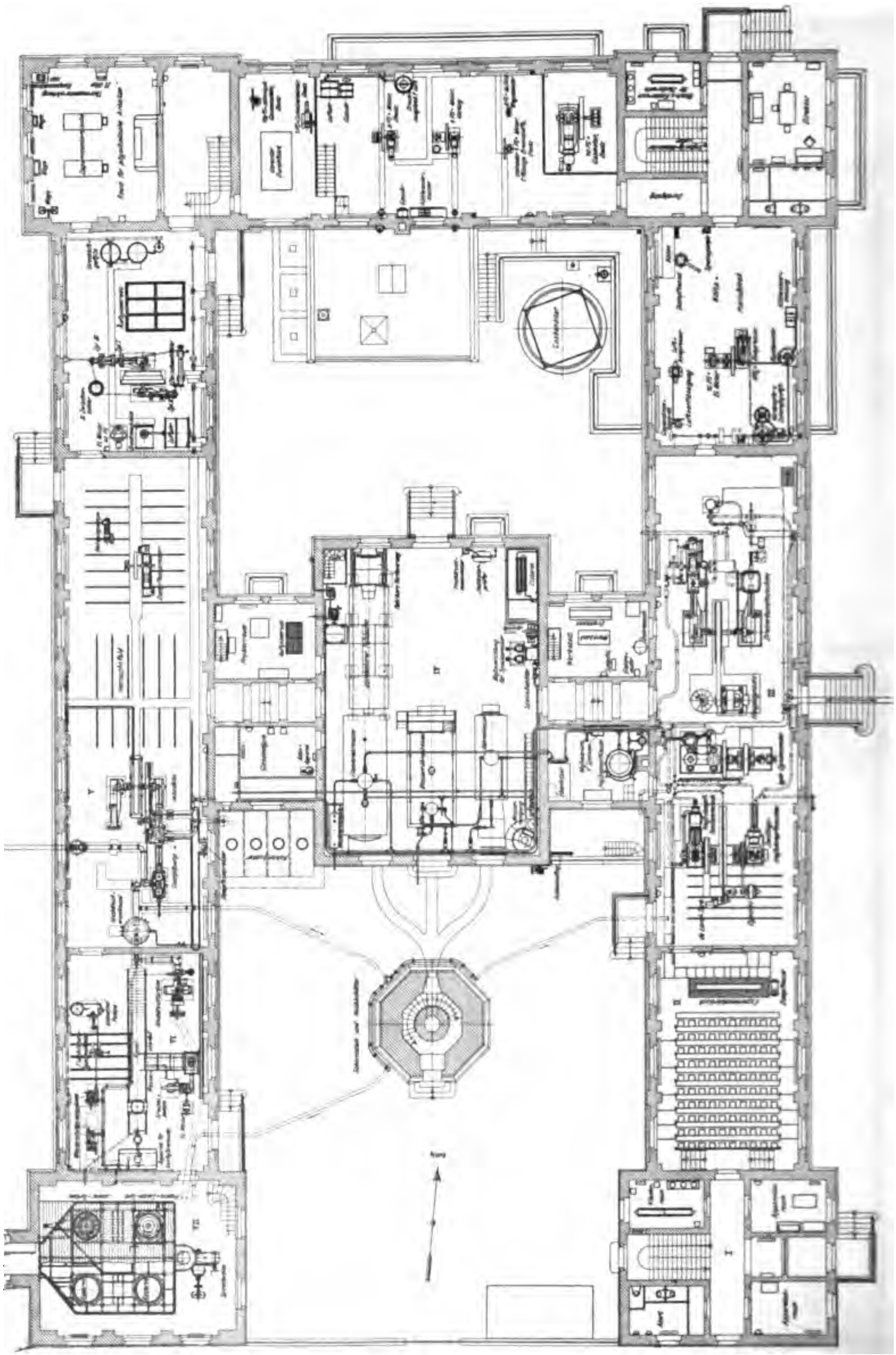
In the main building of the Dresden Technical school is located the main lecture room on mechanics, hoisting machinery and transportation machinery, which is under the direction of Professor M. Buhle, to whom the writer is indebted for the accompanying illustrations, drawings and data. The drafting rooms are also located in this building for this line of study, as well as the extensive collection of mechanical devices of every description, constructed of metal and wood.

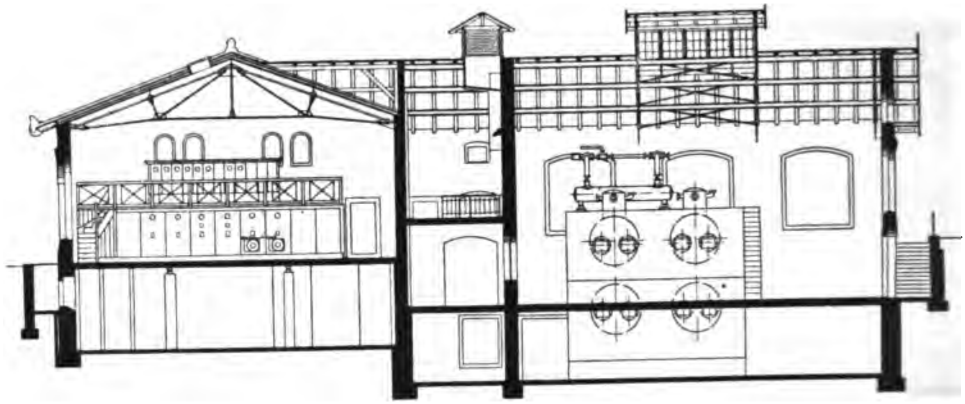
In this building is also located the dynamometric station, a complete electric elevator and hoisting installation for testing work of the Klein system furnished by A. Kuhnscherf, Jr., of Dresden. The machine shops and wood working shops are thoroughly equipped with the latest electrically operated machine tools, including lathes, planers, drills and boring machines, also cranes, electrically driven wood working machines.

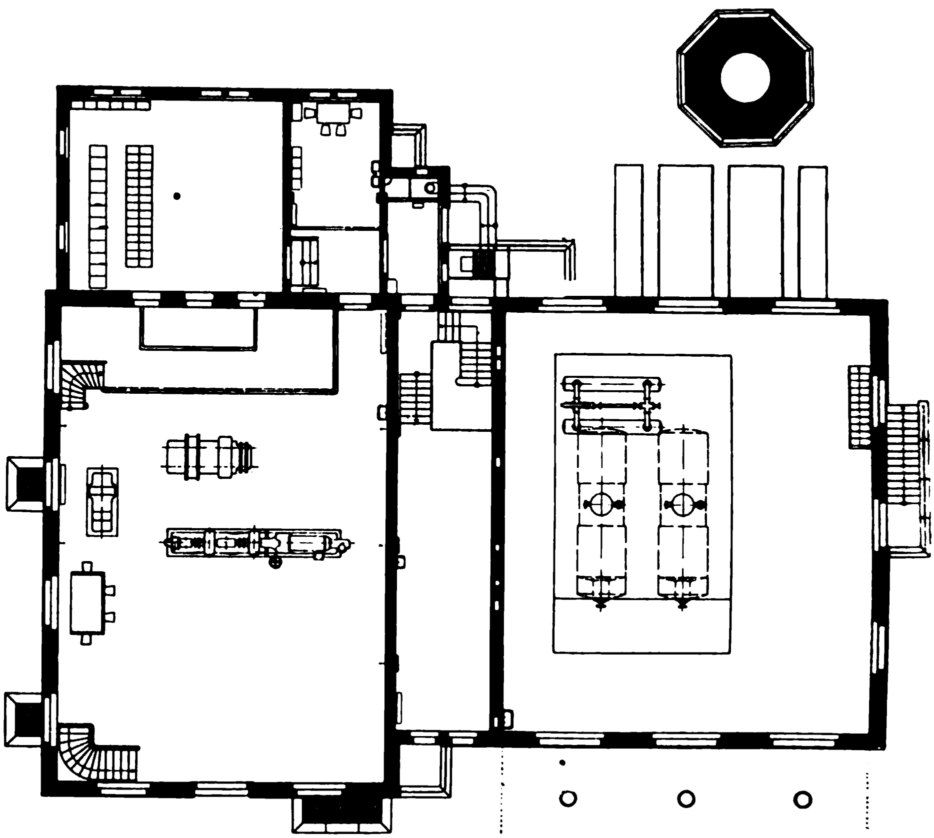
In the mechanical research laboratory there are testing machines for materials of construction, hydraulic presses, accumulators and electrically driven compressors for supplying oil under pressure as well as water under pressure to the accumulator plant. Pro-

Dresden Subway or Tunnel.









visions have been made for testing enormous iron beams, the testing of cement and stone as well as structures built of those materials. Without doubt this German technical institution is one of the finest in the world, for it is claimed that while others may be larger, and more expensively equipped, the work done at Dresden is held to be excelled nowhere.

THE ELECTRO-TECHNICAL EQUIPMENT.

Without doubt the Electro-Technica' Equipment of the Kgl. Sachsischen Technischen Hochschule in Dresden ranks as high as that of any similar institution in the world. This technical college was founded in 1828 and has always been recognized as one of the leading polytechnical schools in Germany.

BUSINESS METHODS.

Philadelphia, Pa., June 15th, 1907.

To the Editor, The Industrial Magazine, Cleveland, Ohio.

Dear Sir:—May I, through the valuable columns of your paper, call the attention of those manufacturers who are interested in engineering industries, to a very important feature of their business, namely, the sales department, which has incorporated with it, their publicity department?

When referring to this department, it is perhaps necessary to show from what sources, and in what percentage, the total volume of business originates; and I think it is generally believed that 50 per cent of the total business originates from personal solicitation, 35 per cent advertising, directly and indirectly, and the balance cannot be accounted for, but which is closely allied with the former.

Advertising space, being in such constant demand, numbers of publications have sprung up, and the advertisements are simply put there for some reason or other, best known to the manufacturer, without very much attention being given to the design and the information which the advertisement ought to contain.

As a reader depends a great deal upon the advertising columns for information, it ought to be that this information should be more specific, instead of simply referring to a trade mark or a heavy cut of a particular machine or appliance, and as an engineer's knowledge of a machine depends upon the information he can get concerning it, in many cases, he has to depend upon the arguments of one manufacturer, because he has neither the time nor the inclination to delve through large quantities of literature which relate collectively to the subject in question.

Regarding catalogues and literature, there is much room for improvement in this direction, as on account of the great competition that exists, a manufacturer must embody in his literature something more than the superlative term, and as his time is so taken with other features of his business, it remains for him to employ the best talent to explain and illustrate his particular products.

In view of the large expenditure a manufacturer is obliged to make, in this direction, he ought to make the most of his space and literature, and these sources of publicity should be part of a complete treatise or work explaining his products.

My experience in many parts of the world leads me to believe that in many cases advertising is looked upon as so much of a speculation, which may or may not pay, but no one can tell whether it does or not; so why bother; and catalogues and literature looked upon as the secret of their business.

If instead of trying to outbid each other for the heaviest type in the advertising columns, a manufacturer would try and show his prospective customers by a lucid explanation, how they can benefit by using his machine or appliance, it would have a tendency to increase his sales.

The time has come when engineering advertising ought to become a special business itself; and is in no way to be allied with general advertising, except from an artistic point of view, and those people who handle it should be engineers of experience, whose ideas do not run on caricatures, or those things which are not consistent with good business, as it is not possible for a man to explain and illustrate the merits of a farinaceous food one day, and the next a semi-automatic capstan lathe.

Many large concerns have their own publicity department which is an excellent thing but the idea should always be borne in mind, that it is necessary to be a specialist in the business you are thinking of becoming advertising expert for, before you take up advertising; although in many cases, the applicant is an advertising man first, and learns the business afterwards.

As advertising, direct and indirect, is responsible for such a large amount of business, why cannot it be made more valuable, and be the means of reducing the expense of personal solicitation?

Respectfully yours,

Algernon Lewin Curtis,
No. 3706 Spruce St., Philadelphia, Pa., and Chatteris, England.

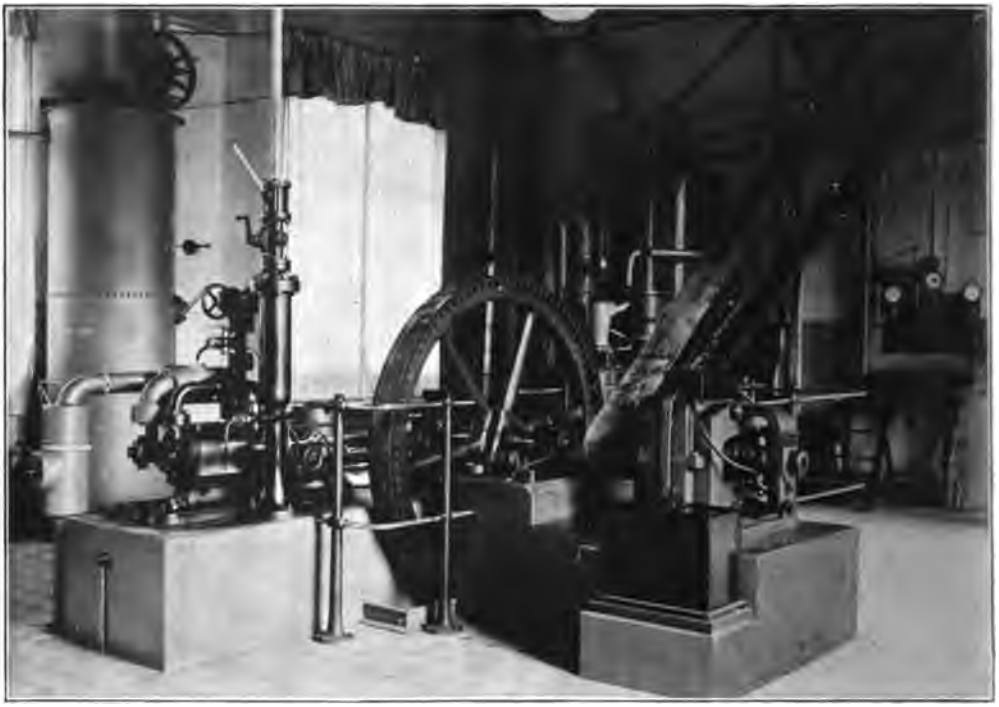
RUBOIL BELTING

For power transmission and belt conveying.

Write for new booklet A.

PHILADELPHIA, PA.

NEWARK, N. J. **BOSTON, MASS**



Electrical and Refrigerating Laboratory.

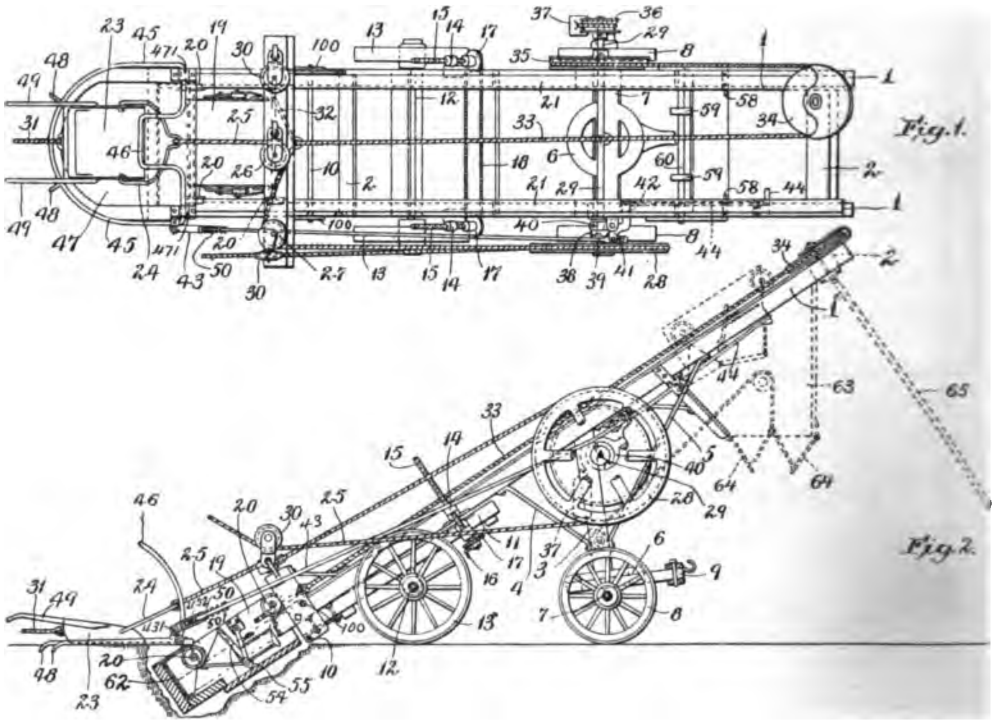
Testing strength of materials of construction at Dresden Laboratory.

NEW INVENTIONS.

Specially reported for The Industrial Magazine by C. L. Parker, 194 Merchants & Mechanics Bank Building, Washington, D. C.

The accompanying illustration shows an Excavating and Elevating Apparatus for which a patent was recently issued to Frederick E. Allen, of San Leandro, Calif.

The lower end of the inclined body rests directly on the ground near the place to be excavated, or, if desired, a small pit may be dug to receive it, as shown in order that the elevating conveyor or carrier 19 may descend finally away from the apparatus under one of the two guide pulleys 30 on either side of the machine The rope may be hitched to a draft animal or it may also be connected with a hoisting engine, and it may be led away from either side of the apparatus, as may be most convenient. 31 is a rope connected to the rear end of the scraper by which the latter may be drawn back. The scraper is not constrained to travel in any specified path, but may be placed in any position and drawn directly toward the elevating apparatus by the drive described



Excavating and Elevating Apparatus.

to the level of the ground. This conveyor is a box-like carriage, having supporting wheels which run on metal rails of the main frame longitudinals 1. The conveyor has on its sides, flanges which extend under the rails and so prevent possibility of the carriage jumping off the track.

The conveyor normally resides in the position shown in full lines wherein it may receive loads of earth brought to it by the excavating scraper 23. This latter has a bail 24 to which is fastened the operating rope 25. The latter passes around guide pulleys 26 and 27; thence over a pulley 28 loose on the shaft 29, and

A New Ocean Route.

From the Philippines comes the announcement that the English Steamship Co., the Blue Funnel lines, will establish the longest route known to mariners as soon as the Panama canal is completed.

Steamers will run from Liverpool to New York, down the east coast of the United States to Panama, through the canal and up the west coast of the United States to Vancouver, thence to Japan, China and the Philippines, or through the Indian ocean to Suez and back to Liverpool.

Personal.

Mr. F. B. Maltby, who has been connected with the Panama Canal work as principal assistant engineer to Mr. J. F. Stevens, has resigned to go with Dodge & Day, Engineers and Constructors, of Philadelphia, in the capacity of chief engineer.

Mr. Maltby is a graduate of the University of Illinois, class of 1882, and in 1907 received an honorary degree from the same institution. He has had a long experience in railroad construction work, municipal engineering and irrigation work, and been connected at various times with the Wiscosin Central, Missouri Pacific, Great Western and Illinois Central Railroads.

He had charge, for the United States government, of all the dredging operations in the lower Mississippi River and designed and built the lock and movable dam on the Osage River in Missouri for the government.

He has been connected with the Panama Canal for the last 2½ years, having had charge of the construction of railroads, docks and wharves, shops and dredging. He constructed a cold storage plant, laundry and bakery in Panama.

Mr. Maltby has designed over $1,250,000 worth of dredging plant for the canal work and the preliminary plans and construction work for the Great Gatun lock and dam were done under his direction.

The American Railways Co., of Philadelphia, have secured property in Dayton, Ohio, and are about to build new car barns and repair shops for the People's Railway Co. Messrs. Dodge & Day, engineers and constructors, of Philadelphia, have been commissioned to draw up plans for the construction of the buildings.

The Cutler-Hammer Mfg. Co. (Milwaukee), makers of electric controlling devices, have just issued a booklet—pigeon hole size—descriptive of their line of electric crane controllers. In addition to full descriptions and illustrations of five types of crane and hoist controllers, the booklet contains connection and dimension diagrams, repair part charts, prices, net weight and shipping weight of apparatus, etc. An improved form of contactor for handling heavy currents is also described.

Three times as much timber used each year as the forests grow, yet thousands of feet are permitted to be shipped abroad. Why not hold it here?

Electrical Show at Madison Sq. Garden, N. Y. City.

COVERING a field in breadth never before attempted, the Electrical Show at Madison Square Garden takes place September 30 to October 9th. Plans are now formed for an elaborateness in electrical decoration of the famous old show place by big firms who have already contracted for exhibiting space that has never been equalled, and the wealth of incandescence to be used in this way will represent a large sum of money. Every big firm in America is interested, and principal among the exhibitors are: General Electric, New York Edison Company, Electrical Testing Laboratories, Driver-Harris Wire Company, Safety Car Heating Company, Brooklyn Edison Company, Standard Roller Bearing Company, Mogul Paint Company, Monatan Construction Company, and others. Among the exhibits will be every invention or device used in commercial or domestic ways, and the most expert demonstrations that can be secured will instruct the crowd during these nine days.

It is the intention of the Brooklyn Edison Company to fit up a modern house, built in the Garden, with every appliance known up to this date. It will be electrically equipped from cellar to garret. This includes electric stoves, electric flat irons and cooking apparatus of every kind. Then there is Milady's boudoir with its electric massage, hair drying machines, electric heating pad, comfort cookers, reading lamps, telharmonic music connection, and in the nursery electric sewing machines and curious toys, windows and doors fitted up with a new burglar alarm, and there are so many other comfort producing devices that it is impossible to mention all.

Each of the firms exhibiting will vie with the others in producing an attractive and interesting exhibit, and it will be an opportunity of a lifetime for out of town merchants to see everything in the electrical world in one visit. The Eastern Cahill Telharmonic Company will fit up the Garden with their wires and give to the visiting public electric music that more than realizes the romancer, Edward Bellamy's dream in "Looking Backward," written nearly twenty years ago. Another marvel will be the Photophone with its vibratory phenomenon. By attaching this instrument to any telephone the person speaking on the other end can be seen,—no matter if it be over the local or long distance telephone—as distinctly as if face to

face. A demonstration of the efficacy of a recently invented burglar alarm will be given by a real live crook from Sing Sing, now reformed.

Other electrical shows have been given before but never of the bigness of the present one. The names of the directors interested give every assurance of completeness in this great educational affair. They are: George F. Parker, president; Walter Neumuller, treasurer; Dudley Farrand, General Manager Public Service Corporation, President National Electric Light Association; Arthur Williams, General Inspector New York Edison Company; W. W. Freeman, Vice - President Brooklyn Edison Company; James R. Strong, President Tucker Electric Construction Company, President National Contractor's Association; James C. Young, Secretary Madison Square Garden.

The New York Edison Co., one of the largest exhibitors, has in mind a plan for the exterior decorations of the Madison Square tower. It is to be one solid bank of lights. and this blaze of incandescence it is expected will surpass even the Dreamland tower in brilliancy.

German and French merchants and inventors have signified their intention of exhibiting at the show, and every prominent firm in America will have space there, and every invention known will have special demonstrators to teach buyers, tradesmen, electricians and the world in general all that is known concerning elec tricity.

"We will have on exhibition everything electrical," said President Parker. "The motors and appliances of automobiles—of course, we will have no complete machines. It is our intention to instruct the out of town trade or any one interested, and everyone who has attained the age of reason is interested in electricity and its uses and mechanical appliances up to date. The show will extend from September 30th to October 9th.

It is the good fortune of the Marion Steam Shovel Co., Marion, Ohio, to receive a contract for six ballast unloaders and seven steam shovels to be shipped to the Panama Canal to facilitate matters there. Since the change of engineers in charge of this work there has been a considerable advancement in the progress there, and these orders are the result of a request for more machinery to rush the work along. It has been reported that Major Goethals has asked to be transferred to some other work, but this has been denied.

The Jacobs Improved Drill Chuck.

It will be observed by viewing the accompanying cut that aside from the toothed sleeve and key, this chuck is similar in design to a number of old and well known three jawed chucks which have won for themselves a prominent place because of their superior construction, desirable shape and compactness.

This class of drill chuck is adjusted or made to unlock and lock a drill by revolving the sleeve upon the body of the chuck. To securely lock a drill, it was necessary to use a spanner to force the sleeve to revolve. The force applied to revolve the sleeve would also revolve the spindle unless it were prevented from rotation by some means. Grabbing hold of the belt was the most common practice. This practice was not only awkward but it ruined the belt, and often the torsional strain applied to the sleeve would twist the chuck off from the shank or the shank out of the spindle, thus wasting time and belts.

This is not all. A drill press operative is provided with two hands only, and as both of these hands are employed in unlocking the chuck, the drill would often fall onto the floor and sometimes be lost. Notwithstanding all the annoying features of the three jawed chuck, it was recognized as the best small drill chuck made, but because of these annoying features many operatives preferred to use the inferior, unshapely two jawed chuck, because it was locked and unlocked with a key, the use of which was not inclined to revolve the spindle.

To combine the good qualities of the three jawed chuck and the convenient locking device of the two jawed chuck was the purpose of the inventor of the Jacobs Improved Drill Chuck. That this purpose has been accomplished is proven by the fact that when this chuck was first placed upon the market it was quickly recognized as possessing great merit, and has since been adopted by many of the leading and most up-to-date manufacturing concerns who buy it exclusively for their drilling department. It is not only good for drilling, but it is a most convenient chuck to use in an engine lathe, etc.

This invention was such a natural solution of the problem that it is no wonder that the inventor thought of it; but the wonder is, as is often expressed when this chuck is first

25 YEARS AGO

of this type which will operate with a positive drive on lowering, as well as elevating, which will also operate under perfect control to hoist or lower within small distances, even one inch at a time, in which a load may be stopped and held at any point of travel, and which will embody such an arrangement and construction of parts hereinafter described, as will enable the apparatus to be controlled both upon the up and down motion and to apply and release a brake by the manipulation of but one lever.

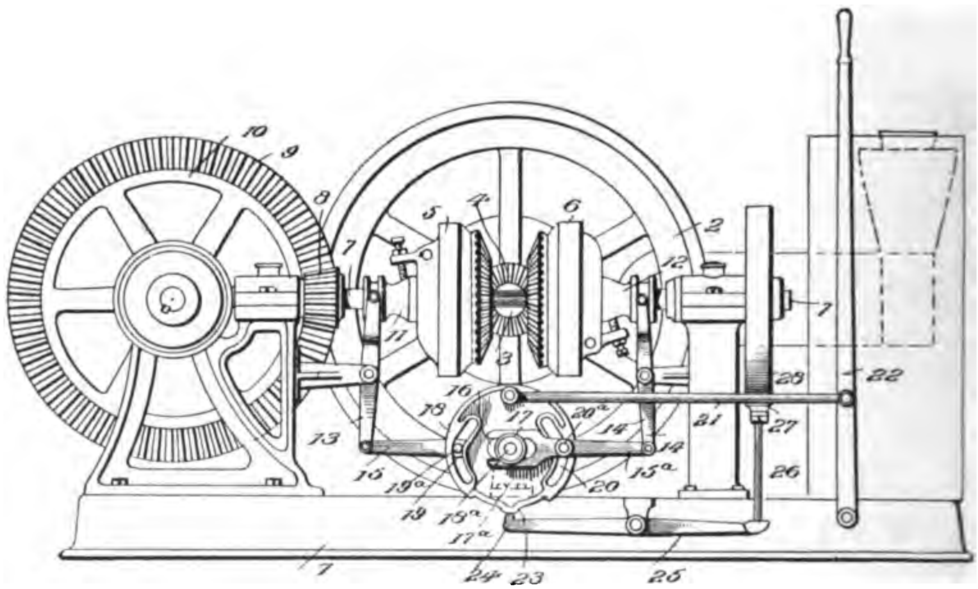
For a full understanding of the invention and the merits thereof and also to acquire a knowledge of the details of construction of the means for effecting the result reference is to be had to the following description and accompanying drawings, in which—

Figure 1 is a front elevation of a hoisting-engine embodying the improvements of my invention. Fig. 2 is a detail perspective view, upon an enlarged scale, illustrating the reversing mechanism.

Referring to the drawings, the numeral 1 designates the bed-plate of the apparatus, and 2 one of the fly-wheels of the prime mover, which is preferably an internal-combustion engine, although not necessarily so.

Three designates the engine-shaft, which is provided at one end with a bevel-pinion 4, meshing at opposite sides of the shaft 3 with two miter-gears secured to or formed integral with the clutch members 5 and 6, which are both loosely mounted upon a longitudinal counter-shaft 7. This shaft is mounted in suitable journal-boxes, as shown, and is provided near one end with a bevel driving-pinion 8, meshing with the miter-gear 9, operatively connected to the hoisting-drum 10, around which the cable is wound.

Two spools or complemental clutch members 11 and 12 are mounted to slide on the shaft 7 and are held to turn therewith in any desired manner customary to devices of this character, and to these spools actuating yoke-bars 13 and 14 are operatively connected, as shown. The bars 13 and 14 are mounted to rock intermediate of their ends upon supporting-brackets on the framework of the apparatus, preferably in a vertical plane. To the lower ends of the rocking bars 13 and 14 sliding beams 15 and 15a are pivotally connected at one end, and said beams extend toward each other and are bifurcated at their adjacent ends, which preferably overlap each other side by side, as shown. The forks 16 of these beams 15 and 15a are mounted to slide back and forth on collars 17. which is supported between two short standards 17a on the bed-plate 1. Also mounted in these standards 17a, and preferably extending through the collars 17, is a bearing-stud 18a, upon which a cam-disk 18 is mounted to partially rotate about its center, as shown. The



disk 18 is preferably provided with two diametrically opposite slots 19 and 20, which receive, respectively, the oppositely-extending pins 19a and 20a of the sliding beams 15 and 15a. To turn the cam-disk 18, it has secured to one side, preferably near its edge, a link rod 21, which is in turn connected to an actuating lever or handle 22, which preferably extends upright, as shown, and is fulcrumed in the bed-plate. At a point diametrically opposite the point of connection of the link rod 21 with the cam-disk the latter is provided with a peripheral cam 23, having a flat "dwell" surface and adapted to engage with the laterally-extending lug 24 of the brake-beam 25. This beam is mounted to rock by being fulcrumed at a point intermediate of its ends, and to the outer end of the brake-beam a brake-rod 26 is connected, said rod extending upwardly and provided at its upper end with a brake-shoe 27, adapted to engage a brake band or wheel 28, fixedly held on the counter-shaft 7.

It is to be particularly noted that the two slots 19 and 20 are curved concentrically with respect to the disk throughout a portion of their length and are substantially straight or otherwise shaped to constitute cams for the remainder of their length.

In the practical operation of the apparatus when the actuating handle or lever 22 is in a true vertical position the peripheral cam 23 of the disk 18 is in engagement with the lug 24, so as to rock the brake-beam 25 and hold it in such a position that the brake-shoe 27 is in frictional engagement with the brake band or wheel 28. If the handle 22 be swung to the left, the cam-disk 18 will be turned in a corresponding direction, and this motion of the disk will be communicated, through the cam portion of the slot 19 and the pin or stud 19a, to the sliding beam 15, so as to rock the bar 13 and carry the spool 11 into clutching engagement with the clutch member 5, thereby causing the counter-shaft 7 to turn in one direction. This motion of the cam-disk 18 is not communicated to the other sliding beam 15a, because the pin 20a of said beam will then work in the concentric portion of the slot 20. To reverse the motion, the same single actuating handle or lever 22 is swung back again beyond the center and to the right, and this will manifestly cause the engagement of the spool 12 with the other clutch member 6 to rotate the shaft 7 in the opposite direction through the instrumentality of the beam 14, sliding beam 15a, and its stud 20a, working in the cam portion of the slot 20. It is also to be particularly noted that whenever the cam-disk 18 is moved to either the right or the left to drive the hoisting-drum 10 either in one direction or the reverse the positive driving engagement is preceded by a release of the brake. This is accomplished by the change in position of the peripheral cam 23, which slides off of the lug 24 and allows the drive-beam 25 to rock in the direction to withdraw the brake-shoe 27. Conversely the cam-slots 19 and 20 are so arranged with respect to the disk 18 and the lever 22 thereof that in stopping the engine the engaged clutch is first thrown into an inoperative position before the brake is brought into play. Hence by this arrangement both in starting and stopping and reversing the engine there will be no undue strain upon the parts, and it is obvious that the hoists may be operated one inch or more at a time and lowered one inch or more at a time and that a load may be stopped and held at any point of travel without interference of the parts. It will be seen that only one lever or handle is used to operate both of the clutches and the brake mechanism in their predetermined succession, so as to control the up-and-down motion and apply and release the brake wherever necessary without the necessity of manipulating several actuating-handles for this purpose.

From the foregoing description, in connection with the accompanying drawings, it will be seen that I have provided a very simple and efficient construction of hoisting-engine, which may be kept sensitively under control at all times and which is not raised by power and lowered by brake only, but has a positive drive upon lowering by means of the herein-described brake appliance.

As one handle alone by the herein-described movements controls all the parts of the hoist in starting, stopping, and reversing the movement of the hoist, it is obvious that only one attendant is necessary for the engine, because a cable may be used, and the man on the first, second, or tenth story or any place between the highest point and the engine may have full control of it.

"Keep Cool."

A GREAT deal of talk about confiscatory methods, endangered prosperity and threatened financial disaster.

"Keep Cool," says Secretary Shaw.

Chancellor Day, of Syracuse University, is distressed over "the use of the court and the prosecuting machinery of the country to direct the frenzy created by a long and persistent yellow appeal of demagogism," and Leslie's Weekly expects the time to come when the people will "look back upon this time of frenzied politics (?) with amazement and indignation."

Yet even Secretary Shaw says "Keep Cool."

"Our farms produce $6,500,000,000 per annum," he says. "Our mines yield more than $1,500,000,000. Our forests yield more than $1,000,000,000. These are not exhausted. Our factories yield $12,000,000,000. Our railways earn more than $2,000,000,000.

"The real sources of the people's wealth have not been affected."

"There are no logical reasons for serious conditions," he goes on. "The people will have exactly what they expect."

What do the people expect—not the masses nor the classes, but the people—what do they expect?

They expect prosperity. They expect honest prosperity, where a dollar is worth a dollar, no more and no less.

And that is exactly what they will get.

Some one asked Secretary Bonaparte if he thought that the great corporations of the country were generally conducted on such unlawful principles that the prosecutions deemed necessary by the government would unsettle industrial conditions and lessen our prosperity?

He replied emphatically, "No."

"The vindication of the law," he said, "can in my opinion have only a beneficial effect on the prosperity of the country, although it may demoralize some speculators."

By some mysterious and subtle mode of communication, the word seems to have been passed around that it is the solemn duty of the classes to blame the masses for alleged existing or threatened financial disaster.

It is a sort of hallmark of social and business altitude to sympathize with persecuted capital to lift one's eyebrows at mention of Judge Landis, and profess great alarm for the future of the country, "if such things are allowed to go on."

In the first place the country is not in danger.

In the second place, enforced honesty and obedience to the law will never put it there.

Don't be alarmed.

The only howl that has gone up (as Sam Jones, the famous evangelist, used to put it) is from the hit dog.—Cleveland Press.

When to Stop Advertising.

An English journal requested a number of its largest advertisers to give their opinions concerning the best time to stop advertising, and the following replies were received;

"When you would rather have your own way and fall than to take advice and win."

"When you stop making fortunes right in your sight solely through the direct use of the mighty agent."

"When you forget the words of the shrewdest and most successful men concerning the main cause of their prosperity."

"When the population ceases to multiply and the generations that crowd on after you and never heard of you stop coming on."

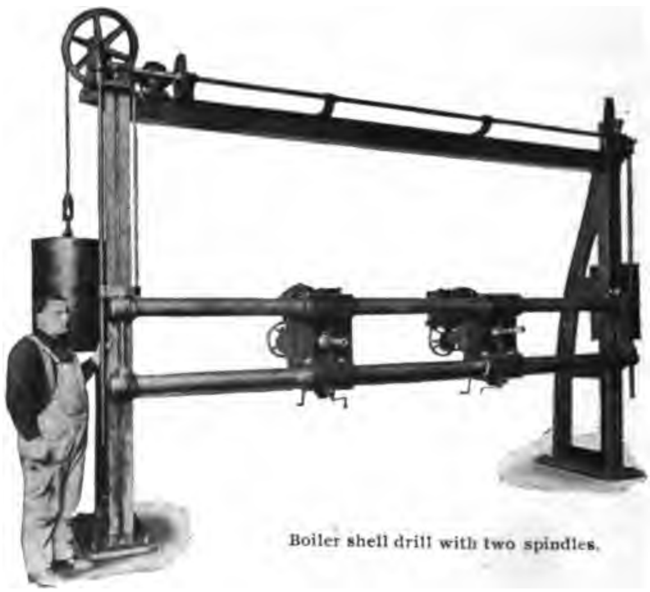
"When you have convinced everybody whose life will touch yours that you have better goods and lower prices than they can get anywhere else."

"When younger and fresher houses in your lines quit starting up, and stop using the newspaper in telling the people how much better they can do for them than you can."

Since 1880 more than 700,000,000,000 feet of timber have been cut in the United States for lumber alone, including 80,000,000,000 feet of coniferous stumpage estimate of the census in 1880.

The spindle is 1 13-16-inches in diameter, is bored for a No. 4 Morse Taper, has a traverse of 18-inches and a perpendicular range through an arc of 15 deg. to permit drilling rivet holes radially to the center of the boiler which is set on rollers in front of the machine. The last movement is controlled by the hand-wheel which appears immediately beneath the gear reduction. The large cut shows one drill-head with the spindle in a horizontal position and the other with it inclined upward.

The feeding mechanism consists of a feed-shaft, crank head, rocker pawl plate, pawl, ratchet wheel, feed nut and feed screw, the thrust of the latter being directly upon the back end of the spindle. The connecting rod between the crank and rocker plate is fitted with a spring which can be set for any pressure of feed, so that it is impossible for this pressure to be exceeded, as the spring is compressed when the limit is reached and the feed ceases to operate until the pressure is reduced, thus making an automatic relief. Change of feed is effected by shifting the thumb latch around the crank head and a range of feeds from .005-inch per revolution of spindle to 1-16-inch can be obtained. This range of feeds covers the entire requirements of drilling in boiler work.


Boiler shell drill with two spindles.

In Germany soundproof building blocks are made of a mixture of gypsum with sawdust, coke, dust or ashes. Some chemical skill is required to make the mixture.

Accidental Inventions.

GAWALOWSKI, in the *Allgemeine Ingenieur Zeitung,* has an interesting article on accidental inventions, in which he mentions first that the phonograph is due to an accident; Edison having related that one day when he sang in the mouthpiece of a telephone, the vibration caused the fine metal point of the diaphragm to stick in his finger, which led him to produce the talking machine. This story is probably not at all new to American readers, but perhaps the history of some other inventions, which took their rise in Europe, may be.

Natural indigo, which is among the dearest dye-stuffs known, and has been used since the twelfth century, at least, has been replaced very largely by the artificial product, which is due to accident. Sapper is said to have discovered it; but Gawalowski states that the invention has been falsely ascribed to Adolf von Baeyer (not to be confounded with Alex. Bayer) and Hermann, although Von Baeyer is always considered as having been the father of this most important discovery. Eosin also owes its existence to A. von Baeyer, who was working at the time in the technical high school in München, and discovered it by accident; in this matter Caro having been of assistance. The Lauth violet and methylene blue were also products of accident; the first being produced by Lauth, and the second by Caro,

with a downwardly inclined extension 40 leading to a suitable receptacle or trough 41, whereby the material may be conveyed to one side of the device for removal. This receptacle 31 and 32, and directly in front of each bucket or trough is supported within the upper frame 17 and adjacent the upper wheels 22, whereby the buckets pass over the top of the wheels and to a horizontal position, the material falls directly therefrom onto the plate 40 or into the receptacle or trough 41. In order to provide sufficient space for the receptacle or trough 41 and to prevent interference therewith on the part of the series of buckets, the frame 17 is provided with a shaft 42 adjacent the rear end thereof, and this shaft supports wheels 43 similar to the wheels 22 and 19. The series of buckets runs from the wheel 22 across above the frame 17 in a substantially horizontal line to the wheels 43, from which they descend along an inclined plane to the lower wheels 19 adjacent the bottom of the ditch.

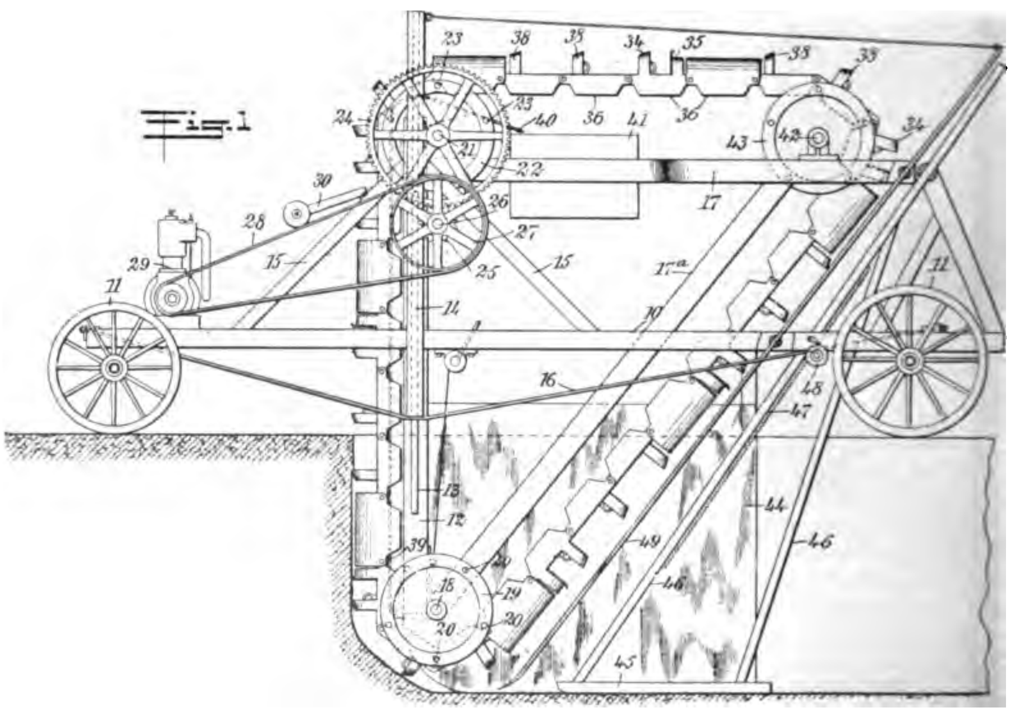
The machine is the invention of George M. Schnell and C. N. Schnell, of Kellog, Iowa.

PORTABLE ELEVATOR.

The object of this invention for which a patent was recently issued to John Beach, of Harwood Mines, Pennsylvania, is to provide a construction of traveling or portable elevators, designed for handling various loose materials in bulk, and adapted to rapidly elevate the same from a bank or pile for loading cars or wagons, or for delivering the material to a conveyor line, or other place.

In practice the track which supports the elevator will be laid in four or five foot sections, and there will be sufficient space between the front wheels and the elevators to permit a section of track to be placed in position for extending the track already laid. The central conveyer, which is arranged between the rails, and the side conveyers, which project laterally beyond the rails are adapted to not only load the material upon the car, but they also clear a space sufficiently large for the machine to follow up its work without hand shifting.

When moving the machine from one place to another, the bottom buckets may be taken off. The bearings 16 are adjusted by means



Ditch Digging Machine.

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From an artistic point of view, the book is a success in every detail, the grouping of the numerous illustrations and arrangement of text being in especial good taste and very effective.

The whole is enclosed in a cover of rich deep brown color embossed in gold and printed in three colors from an original design of unusual strength and appropriateness.

Contrators, engineers and others will welcome the latest edition to commercial literature. It brings to their hands a valuable fund of information regarding the wide possibilities of high grade digging machinery as built by The Hayward Company.

Catalog Review.

The Ingersoll-Rand Co., 11 Broadway, New York, are sending out bulletin, form 410, showing some mechanical applications by compressed air in the cotton industries.

The catalog of Gears has been issued by The Philadelphia Gear Works, of which George B. Grant is president and mechanical engineer. This catalog contains much description of gears and gear cutting.

The Raymond Brothers, 143 Laflin street, Chicago, Ill., have issued a small monograph entitled "Making Air Make Money," which describes the Raymond system of grinding and separating.

The Parker Hoist & Machine Co., Chicago, Ill., have issued a catalog on their derricks, engines, cranes and hoists. An illustration of their Parker derrick is given on another page of this magazine.

American concrete mixers are illustrated in a catalog issued by The International F. & Fireproofing Co., Columbus, O. These machines are shown in a great many styles and a great variety of classes of work.

Gas power excellence, as presented by The Angola Engine & Foundry Co., Angola, Ind., describes gas and gasoline engines for electric lighting, water works, irrigating, ventilating, grain elevators, brick and tile mills, saw mills, etc., etc.

I. H. G. gas and gasoline engines are described in a catalog issued by The International Company of America, Chicago. It also includes sawing outfits, pumping jacks, gas attachments for the use of gasoline engines for a great variety of services.

The Cutler-Hammer Clutch Co., Milwaukee, Wis., have issued a booklet on lifting magnets, in which the descriptive matter is given first and then a set of eight or ten actual photographs are included, making a very neat arrangement.

The B. F. Barnes Co., Rockford, Ill., have issued an illustrated catalog of their 20th century machine tools, including upright drills, gang drills, lathes, tool grinders, key seaters, etc. The catalog is 6x9 and has 88 pages printed on good stock and with fine illustrations.

The Drake Standard Machine Works, Chicago, Ill., have issued a catalog of concrete asphalt and mortar mixing machinery, either of the continuous or bath mixing description. The illustrations are taken from actual practice and show the machines in a great variety of uses.

The Safety Meter Lock Co., Columbus, O., have issued a catalog on safety seals for gas and water meters, unions, stopcocks, meter locks, railway cars and other purposes. The catalog is 6x9, well illustrated and contains much useful information in regard to these articles.

The Chicago Concrete Machinery Co., 20 South Canal street, Chicago, Ill., have issued a catalog on concrete mixing machinery which contains many good illustrations. This company are making some experiments of their new designs, which will be ready for description.

The Males Co., Cincinnati and New York, have issued list No. 30 of Railway and Contractors' Equipment. This consists of locomotives, steam shovels, dredges, standard gauge freight cars' equipment, narrow gauge passenger equipment, Bassast unloaders, cableways, etc.

25 YEARS AGO

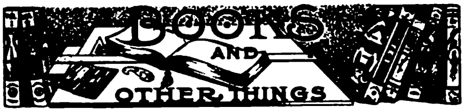
caused to travel to and from upon these idlers.

Still another object of the invention is to provide the tripper or deliverer with an improved mechanism by means of which movement in either direction may be imparted thereto from the conveyer-belt without changing the direction of travel of the belt and without making use of traction-wheels engaging a track or equivalent structure.

The invention also contemplates the production of a novel tripper or deliverer for belt conveyers of very simple and inexpensive design which is adapted for thoroughly satisfactory and efficient operation.

With these objects in view and others, which will hereinafter appear, the invention comprises certain novel features of construction, combination, and arrangement of parts which will be hereinafter described, reference being had to the accompanying drawings, in which corresponding parts are designated by similar characters of reference throughout several views. It is, however, to be understood that changes may be made in the apparatus without departing from the spirit of the invention or exceeding the scope thereof, which is clearly defined in the appended claims.

A tripper or deliverer constructed according to the present invention comprises an elongated or extended base of sufficient length to extend over and rest at the same time upon a plurality of spaced supporting members, a framework for the support of two or more bend-pulleys or other suitable devices for causing the belt to discharge its load, and a hopper or its equivalent to receive the material discharged from the conveyer-belt. The invention also comprises means for retaining the tripper or deliverer in proper alignment with respect to the supports upon which it rests and suitable mechanism for imparting movement to the tripper or deliverer in the direction of its length.



The Factory is the name of a new monthly publication which will be issued Nov. 1 by the System Company of Chicago. It is announced that it will be devoted exclusively to those interested in manufacturing, particularly factory owners, superintendents, foremen and business executives generally. A. W. Shaw is the editor. The contents of the first issue are made up of descriptive articles. It will have thirty-six pages and a number of half-tones.

Longmans, Green & Co. announce the removal of their Chicago office to 84 Wabash avenue, where they hope it will be for the greater convenience of their customers in the Middle West, where supplies of a selected list of their educational books will be kept in stock. All orders for miscellaneous books must be sent to the New York office, as heretofore, located at 91 Fifth avenue, New York City.

Economical Machinery for the Coal Mine. Ingersoll-Rand Company, 11 Broadway, New York. Form 53A. 24 pages 3¼ x 5½ inches, 15 half tones. This neat and handy leaflet gives a variety of information concerning the various machines for the coal mine manufactured by this company. Ten entirely distinct lines of apparatus are treated of, all up to date and of the highest efficiency in their respective classes.

The McMyler Manufacturing Co., Cleveland, O., have issued a catalog on locomotive cranes, bridge conveyors, grab buckets, car dumpers, etc. The illustrations clearly define the many uses to which these machines can be placed and the illustrations are very concise. The catalog also includes the well known Hayward patent orange peel buckets.

The D. T. Williams Valve Co., Cincinnati, O., has issued a complete catalog and price list of high grade engineering appliances, consisting of brass and iron valves, gauge-cocks, fittings, oil and grease cups, lubricators, steam traps, separators, etc. The catalog is exceptionally well illustrated and is of 160 pages and includes a few pages of general information.

The Peerless Motor Co., Lansing, Mich., are sending out circulars on their gasoline engines and contractors' hoists, which are built at various sizes, a 5-hp. vertical four cycle engine and double drum geared hoist, having a capacity of 1,000 pounds, 150 feet per minute, or 2,000 pounds, 78 feet per minute, both mounted on one base, thus making a neat, compact and rigid outfit.

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HANDLING GRAVEL WITH A "LEVIATHAN" BEL

overhead "I" beam track. The entire equipment is controlled by an unskilled operator, who rides in the cage, also being in a position to dump and handle the bucket from the cage. An operator with an equipment of this class will handle a large tonnage at little expense for power. The coal may be handled by means of the regular bucket shown or by means of a grab bucket, unloading direct from the car and delivering to the boiler room.

Fig. 4—A 2-ton trolley hoist handling coal and ashes in boiler room of street railway power house. This equipment gives a traversing speed of 850 feet per minute, and a llfting speed of 20 to 25 feet per minute. The track consists of standard structural I-beam. The operator's cage is dropped to a point where he can not only control the hoisting and traversing movement of the machine, but at the same time can dump and manipulate the bucket from the cage. The crudest of labor only is required for operating this equipment. One man will handle a large tonnage in a day.

The ashes are readily handled by means of the regular dump bucket, which may be placed in front of the boilers, so that when full, the trolley hoist may be brought in position, the bucket attached to the lower hook, carried away and dumped and returned to the point for refilling. The equipment gives a traversing speed of 350 ft. per minute and a lifting speed of 15 to 20 ft. per minute. These speeds have been found to be best adapted to this class of service, in the hands of inexperienced operators.

A common application of hoists about a car barn or repair shop is for handling the motors to and from the car trucks for lifting the trucks and axles and for handling such parts to the lathe. Illustration No. 5 shows a portable electric hoist hooked in a jib crane and placing a pair of wheels in a heavy lathe. The same type of hoist is used attached to the bridges of overhead traveling cranes and worked in tandem for lifting the end of the car, so that the trucks can be run out from under the body.

The portability obtained in the hoist by balancing the entire mechanism on a single top hook greatly facilitates the application of such a hoist to these varying uses about a car barn or shop, as a hoist of this class can be easily attached to any overhead support and at the same time lift or pull at an angle.

The controller is usually attached direct to the hoist, and operated by means of pendant cords. Where it is desirable the controller may be placed at a stationary point, so that the hoist may travel on an overhead trolley or the bridge of a traveling crane. In this case the controller and rheostat are removed from the hoisting motor, and placed on a convenient column, or on the wall. Every function of the machine is thus controlled from a stationary point.

Illustration No. 6 indicates applications of this character. The large traveling crane in the foreground is equipped with a portable electric hoist, which is shown suspended about the center of the bridge. The controller and rheostat are removed from the hoist and placed in the operator's cage at the right. All functions of the crane are controlled from this cage.

A very economical application of the portable electric hoist is shown in illustration No. 7. The several hoists shown are hooked in trolleys on the jibs of cranes. Each crane is mounted in such position that the hoist can

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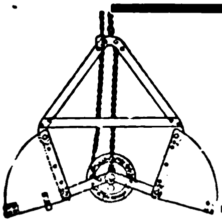

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Volume VII. Sixth Year. Number 6.

CONTENTS FOR DECEMBER, 1907.

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Alphabetical List of Advertisers, Pages 4-6. Classified List of Advertisers 47-51. Buyers' Guide, Page 41. Classified Advertisements, Pages 37-39

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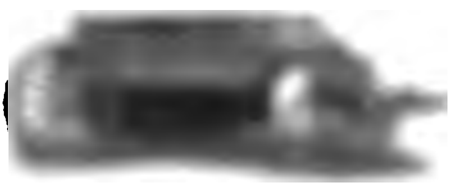

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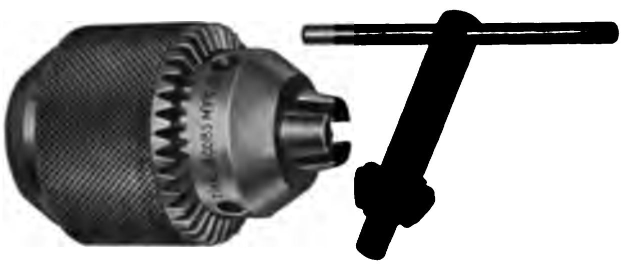

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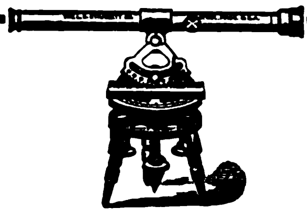

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